DISCOVERY

A Monthly Popular Journal of Knowledge

March 1935

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DISCOVERY

A Monthly Popular Journal of Knowledge

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Notes of the Month.

Pronouncement was made, on the last day of January, of the findings of the Television Committee, under the chairmanship of Lord Selsdon. As was to be expected, the Committee's report indicates cautious progress, but it would seem probable that, before the end of this year, reception of televised programmes will be available to the general public. It is recommended that the B.B.C. (who have been for some time sending out experimental television programmes) should be in sole charge of the transmission; in these days, when even established private enterprise meets with official disapproval, it was hardly to be expected that so universal a service as television could escape semi-official monopoly. Unrepentant critics of the B.B.C. and its policy may console themselves with the knowledge that another target will be offered to their darts. Yet the bogey Competition raises its head even here, as there are two systems—the Baird and the Marconi-E.M.I.—which claim equal attention from the transmitting authorities. The suggestion is that a transmitting station shall be established in London, using each system alternately.

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The Postmaster-General thought it advisable to reassure the House of Commons that no further invasion of domestic privacy was threatened. We should scarcely have thought that such assurance was necessary, or, for the matter of that, that the House was especially interested in guarding the privacy of the home. The televised programmes will, in fact, be under the strict censorship of the B.B.C. authorities, and no speaker on the wireless need be made visible to his listeners unless he so wishes. The ultra-short waves which will be used for transmission have the advantage of being unaffected by atmospherics, but, as an offset, they have a very limited range, restricted to about 25 miles. Unless a means can be found of extending this range, it may be necessary to erect a large number of transmitting stations in various parts of the country. The report recommends that an advisory committee be set up to consider this and other questions; some critics have thought that the suggested membership of this Committee is too "official," and that more places should be awarded to representatives of the firms manufacturing the apparatus.

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The Baird Television Company, on the Tuesday following the publication of the report, gave a very interesting television transmission at its Westminster offices. Both direct transmissions from the studio and delayed transmissions of scenes in the vicinity of the studio were exhibited, and results were excellent. At present the Company has two types of receiving sets combining both sound and sight reception, ready for immediate production. The cost will at the outset be £50 and £80 respectively, according to the size of the picture produced on the screen (12 in. by 9 in., or 8 in. by 6 in.), but it is expected that, with the increased demand anticipated, it will be possible to lower these charges materially.

* * * *

Mr. Edwin Thompson, president of the Society of Chemical Industry, speaking at a dinner held in Birmingham this month at which leading British chemical societies were represented, pointed out the crying need for the co-ordination of scientific societies in England. He referred to the opening of the Maison de la Chimie in Paris, which housed all the chemical societies of France, and suggested building on the site of Burlington House—a magnificent site but, at present, an antiquated building—a new home for all the scientific societies of the country, not merely for chemical societies, as in

France, but for all branches of science. The time had come, he suggested, to take the definite step of forming an influential committee to approach His Majesty's Government and find out what support such a proposition would receive from them.

* * * *

The malaria epidemic which has been ravaging Ceylon, the suggested causes for which were reviewed in the January issue of *Discovery*, has had the merit of directing intensive medical research on to the problems of this disease which some of us perhaps believed to have been thoroughly under control in most parts of the globe. A correspondent of *The Times* gives some interesting information, acquired from Dr. Peter, of the tropics department of the German Dye Trust near Frankfort-on-the-Main, regarding the preparation of the new atebrin, the drug which has been applied so effectively at the Colombo General Hospital. Atebrin in its original form, as produced by the chemists of the Elberfeld laboratory of the German Dye Trust, was first used in 1930. It then had to be taken through the mouth ; but the new form is much more easily soluble, and when dissolved in distilled water, can be conveniently used for injections. With a dose of three grammes a day, it is stated, the worst form of malaria can be completely cured within five days without adverse effects on the patient, and with few relapses. This compares very favourably with quinine, where short-period treatments are often followed by bad relapses, and long-period treatments by permanent harm to the patients.

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The utilisation of unemployed labour for archæological work has been developed further in the Irish Free State than in Great Britain, with the result that the National Museum in Dublin has been greatly enriched, and that knowledge of the prehistory and early history of Ireland increases by leaps and bounds. Mr. O Ríordáin, of the National Museum of Ireland is contributing an important article on recent excavations to our April issue. The accompanying photograph illustrates the first " find " at Cush, an important site in Co. Limerick which he has been dealing with personally. We have never ceased advocating this non-competitive use of available idle labour ; but local ignorance and prejudice too often block the advance of knowledge, and what should be regarded as a national concern is held up because of a stubborn insistence on the use of uncertain local labour.

Finding the first urn at Cush, Co. Limerick.

* * * *

Report of an extremely interesting biological and bathygraphical expedition has recently come to hand. The Egyptian Government has commissioned a vessel to investigate the floor of the Red Sea, including the Gulfs of Suez and Aqaba, and the results already attained are of the highest importance. Submarine hills and valleys have been found bordering the coast, which form the foundations of the coral reefs when they come near enough to the surface. Some of the coral reefs appear to be flourishing, while others are decaying —under apparently similar conditions—to form dangerous shoals ; no reason for this erratic behaviour has yet come to light. Most notable is the finding of a huge trough, 960 fathoms deep and previously unsuspected, in the Gulf of Aqaba. It is interesting to learn that save for one foreigner the personnel of the expedition is entirely Egyptian.

* * * *

Deserved attention has lately been drawn in the Press to the questionable policy of the Forestry Commission in planting an inordinately high proportion of coniferous trees. Mr. Alexander L. Howard writes an especially cogent letter to *Nature* drawing attention to the destruction of hardwood trees all over the country. Since no check is kept on the felling of trees, the immediate result is a loss of amenity in the countryside, while in the future we are threatened with the creation of barren wastes such as have been caused by indiscriminate timber-felling in the United States. Another danger is that of fire. Fire-breaks are, of course, left open in the new plantations ; but after a dry summer, wind-driven flames will leap them and devour the dry resinous softwoods like tinder ; whereas a little judicious intermixture of hardwoods would act as an effective check. Stringent regulations governing the felling of trees exist in the majority of European countries ; and since the Forestry Commission exists, would it not be well to use it to the best advantage ?

Spring Migration of Birds in Western England.

By E. W. Hendy.

Mr. Hendy's books on bird-watching are classics of the bird world, and his observations of the movement of migrant birds last spring are certainly of importance beyond the area in which they were made. It is to be hoped that they may serve as a model for similar studies in other areas, both within and beyond the British Isles.

DURING the spring of 1934 the Bird-watching and Preservation Societies of Devon and Cornwall, in co-operation with the *Western Morning News*, instituted a study of the migration of birds in the Western Peninsula. The scheme originated with Mr. A. H. Machell Cox, the well-known West Country ornithologist. Six species were chosen for observation—wheatear, chiffchaff, swallow, cuckoo, common whitethroat, and spotted flycatcher—and competent observers were appointed throughout the district who each week filled up forms recording the arrivals and, where possible, the movements of the selected species, and returned them to me. Reports of the weather in south-western England and Europe were also sent to me weekly by Mr. G. M. Spooner of the Marine Biological Laboratory, Plymouth. At the end of each week my comments upon the records, with a map, were printed in the *Western Morning News*, and at the end of the season my summaries of the results were published in the same newspaper. As the results are of more than local importance the editor of *Discovery* has allowed me to give a condensed account of them in this article.

First, with regard to weather conditions, it is often overlooked that, as both Dr. Eagle Clarke and Professor A. Landsborough Thomson have pointed out, the major factors in migration are the weather conditions where the flight began; if birds arrive on our shores under adverse conditions it is probably because the flight started when conditions were good, but the weather changed during the journey. Also, all sound authorities admit that wind has a relatively unimportant influence on migration. High winds are, of course, unsuitable, but if a wind is light or moderate its direction seems not to matter. As the general trend of migratory movements is constant year by year, it follows that most birds have the power to rectify their errors in flight if carried out of their course.

Weather Conditions.

The observations continued from March 18th to June 2nd. The weeks March 26th to April 1st, April 16th to 22nd, April 30th to May 6th, May 7th to 13th, 21st to 27th, and 28th to June 2nd were, generally, favourable to migration, but during the other weeks, when the weather was generally unfavourable, there were nights or short periods when conditions were good.

A detailed examination of weather conditions during the whole period shows that "rushes" usually took place when weather favoured migration. Thus, on the nights of March 30th and 31st, and early on April 1st, conditions approximated to what Dr. Eagle Clarke calls "ideal south-easterly conditions"; accordingly there was a considerable influx of wheatears and chiff-chaffs in Devon, Cornwall, and West Somerset, both on the coast and inland. Again, on March 25th, when the weather was calm, and there was a marked rise in temperature, a flock of sixty or seventy wheatears was seen resting on a hillside near Ilfracombe. But sometimes, when meteorological factors seemed perfect, there was no marked movement, but rather a general flow of incoming birds. For instance, during the week May 7th to 13th, when the weather was anticyclonic, with negligible winds and a higher temperature, though there was throughout a good deal of migration in progress, there were no marked "rushes." Also, normal migration often takes place when wind and weather appear adverse. The unsettled conditions from April 23rd to 29th were against migration, but swallows, cuckoos, and whitethroats all increased towards the end of that period. Sometimes a "rush" occurred in the middle of an apparently unsuitable time; the week April 2nd to 8th was generally discouraging to migrants, but the night of the 3rd was calm, and on the 4th a flock of seventy wheatears was seen near Holsworthy in mid-Devon.

High Roads of the Air.

Some ornithologists hold that birds have definite fly-lines or routes that they always follow; others believe that they travel on a broad front over the whole of the country lying between their breeding and wintering quarters. The records, in my opinion, show quite clearly that in the western peninsula, though there is probably migration on a broad front, yet many birds follow coast-lines and river valleys where they can find food while resting on their journeys. These routes may be called "bird bridle-ways." I have written more fully on this in Chapter XVI of my book *Here and There with Birds*. One very popular fly-line passes all along the north-west and northern coasts of Cornwall, Devon, and West Somerset; in 1934 there were numerous records all along that route of all the six selected species, except cuckoo and spotted flycatcher, and in previous

years the same has been noticed. I call this route " the West Coast Route." It may extend as far south as the Isles of Scilly, and a branch of it probably passes over Lundy Island. Migrants using this path may proceed later up the Gannel, Camel, and Taw and Torridge rivers. All the rivers on the south Devon and Cornish coasts are used as " bridle-ways " in the same manner. Reports are specially numerous along the Fal estuary, and that ganglion of rivers—Lynher, Tamar, Tavy, Plym, and Meavy—which run into Plymouth Sound ; the Exe and Otter also are crowded highways. There are, of course, cross-country routes as well, which I shall mention later when discussing the tracks used by the different species.

Early and Late Arrivals.

The accompanying map, which is adapted from one of those published in the *Western Morning News* by the kind permission of the Editor, shows roughly the principal routes and bridle-ways favoured by swallows : the movements of these birds are fairly typical of the six selected species, except the spotted flycatcher, which arrived almost entirely in south and east Devon. On the map " S " shows swallows reported, but direction of flight not stated ; where the direction was reported this is indicated by an arrow. The flight directions in Plymouth Sound and the Exe estuary are so numerous that it is impossible to show all of them.

The duration of the wheatear's migratory period was surprising ; it extended from March 18th to May 20th. The earliest wheatears were seen along the West Coast Route, but some arrived near Torquay only a few days later. The bulk of the wheatear migration occurred between March 30th and April 11th, but throughout April and up to May 20th a few were still passing. Some of these later birds probably belonged to the Greenland race, but only one or two were definitely identified. The West Coast Route was much favoured by wheatears from the Isles of Scilly to the Quantocks, and included Lundy Island. But there is also a cross-channel passage ; tired wheatears were seen near Torquay on various dates in March and April, and others at different points on the south Devon and Cornish coasts. There was also a number of records from March 25th to May 13th on or near the Exe estuary. Some of these south coast arrivals passed overland to Dartmoor and the high-lying country inland, for there are many records from these districts ; probably they followed the river valleys northwards.

The migration of the chiff-chaff also went on for a longer period than had been suspected. It began as early as March 10th, yet some chiff-chaffs were still passing during the first weeks in May, and " new " birds were noticed even on May 18th and 21st. The majority arrived between April 1st and 17th ; there were " waves" on April 7th-9th, 11th-12th, and 14th-16th. Earlier arrivals on the south Devon coast and the Isles of Scilly had passed on by the end of April ; it is significant that not till about that date were chiff-chaffs normal on Dartmoor and on other high-lying inland country. Generally, the records show that the West Coast Route and the river valleys leading northwards from the south coast were the principal " bridle-ways " used.

Swallow migration was in progress for two months. The first trustworthy report came from Bideford on March 29th. One bird was seen at Slapton Sands, S. Devon, on April 4th, one near Plymouth, one at Tresco, Isles of Scilly, and one near Sidmouth on April 6th. The greatest numbers arrived between April 15th and 23rd, but there were " waves " or " rushes " on April 7th, 29th, and 30th, and between May 1st and 4th. Small movements were noticed up to May 27th. The West Coast Route was used continuously throughout April and up to May 12th ; some of the movements recorded there are important. At Bull Point and Morte Point (west of Ilfracombe), on the evening of April 26th and the early morning of April 27th, passages of swallows were noted to south, south-west, west, and north-west, directions which would take them towards Hartland Point, Lundy Island, and Wales. It is significant that swallows seen on the Porlock coastline, and inland, between April 15th and 22nd were flying courses which would lead them also towards Hartland or Morte Point.

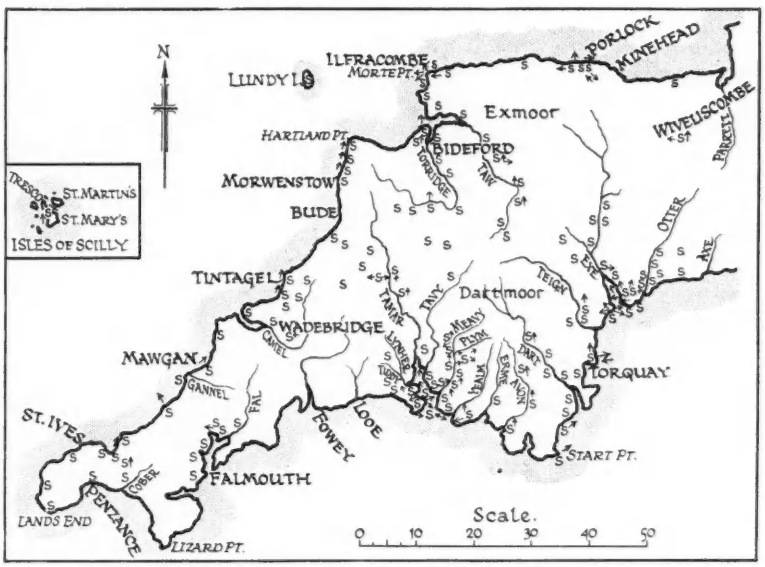
The Swallows' Flight.

Again from May 1st to 4th there was a movement of swallows to the north-east along the north-west coast of Cornwall, and on May 10th, 11th, and 12th in the same direction along the north Devon coast between Morwenstow and Hartland. Swallows arrived at the Isles of Scilly from April 6th to 29th, and on May 11th, and at Lundy from April 10th to 14th. Those dates coincide with other swallow arrivals on the West Coast Route, so presumably this was the course followed, though on April 16th one party of eleven departed from Tresco (Isles of Scilly) towards the south-east, a direction that would take them to Ushant.

Numbers of swallows arrived near Torquay on various dates from April 13th to May 13th ; many of them were seen flying north-west ; these, and others recorded elsewhere on the south and east coasts of Devon, passed northwards both up the river valleys and overland to the shores of the Bristol Channel. Arrived here, a few of these northward bound birds turn east, but the vast majority turn west. Farther on they must cross the

Channel, perhaps at or near Morte Point or Hartland Point; later they may join the well-known migration routes along the west coast of Wales or the east and west coasts of Ireland. Other swallows arriving on the south and east coast of Devon seem to follow the coastline both to the east and to the west; their final destination can only be surmised. Few swallows were reported as arriving on the south Cornish coast.

The cuckoo was heard at Tresco on March 22nd and 23rd, and there were several "good" records from Devon during the last week in March. Migration was most active from April 15th to 29th, but there were some probably new arrivals up to May 17th. They were late in arriving at the higher ground north of Dartmoor. Some of these cuckoos used the West Coast Route, but by far the greater number were recorded in south and east Devon, and there is evidence of a definite cuckoo migration from south to north in these localities. Observations from near Torquay and near Modbury (S. Devon) both in this and previous years, reveal the interesting fact that cuckoos arrive in the same spot each year very early in the morning, and then, after a short rest, pass northwards. Reports from south-west Cornwall were few.



Map showing migration of swallows in S.W. England in Spring, 1934. S—Swallows reported, direction of flight not stated unless an arrow is added.

Whitethroats and Flycatchers.

The first whitethroat was reported at Mincarlo, Isles of Scilly, on April 5th and 6th. Records after this date were few till April 28th-29th, when there was a "wave" along the West Coast Route, in south and east Devon and in south Cornwall. A "glut" was reported near Torquay from April 30th to May 6th. During this week they became normal in nearly all districts. But in inland localities they were still scarce, and during the second, third, and fourth weeks of May, though in many places nest-building was well advanced, and in some cases young were hatched, whitethroats were still arriving and passing. Many used the West Coast Route, but some made a leisurely progress northwards along the south Devon river valleys. That some were still moving at the end of May when others had young is an interesting discovery. Spotted flycatchers came very late in 1934. There was only one reliable report, from north Devon, on April 21st, and by May 14th less than a dozen had been recorded. Most arrived in the third and fourth weeks of May, but others did not come till the first week in June. Nearly all the arrivals were in south and east Devon. They were very scarce along the West Coast Route. Probably those seen inland had journeyed overland from the south coast. Reports from Cornwall were few: the species appears to be uncommon in that county. Some observers report flycatchers as scarce that year, but a Torquay correspondent found them numerous.

It will be seen from the above that these observations have already achieved results of considerable importance; if continued over a series of years they will become valuable. Perhaps other Natural History Societies will undertake similar investigations; the results could then be co-ordinated and this would add greatly to our knowledge of migration in the British Isles. The observations in Western England are being continued in 1935.

Science on the Road.

Bringing Science into the Road Traffic Problem, by Col. Mervyn O'Gorman, has been published as a pamphlet by the British Science Guild, and copies—price 1s. 1d. each including postage—are obtainable on application to the Secretary of the British Science Guild, 6 John Street, Adelphi, London, W.C.2.

Recent Excavation at Petra.

By a Special Correspondent.

We are indebted to the Melchett Petra Exploration Fund for the following account of the excavation of the remarkable circular building, known as the Conway High Place, at Petra. The description of the excavation work is by Dr. W. F. Albright; for the introductory and general material we have to thank the Hon. Mrs. Horsfield, Hon. Sec. of the Melchett Fund. The information collected concerning pre-Islamic Arabian civilisation is of the highest importance.

PETRA, owing to the political conditions that prevailed before and immediately after the war, had never been submitted to more than a surface examination, though it was on a tourist itinerary run by Thos. Cook and Son from Egypt and was visited yearly by this means. Found by Burkhardt in 1812, some of the monuments were drawn and published by David Roberts in 1839. Musil explored and planned much of it for the first time (Arabia Petræa, Vol. II, 1907-08) and Brunnow and Domazewski, in their monumental work, *De Provincia Arabia*, made an inventory of the monuments. Dalman, in *Petra und seine Felsheiligtümer*, has studied its sanctuaries and during the war Wiegand made a record of the buildings in the centre of the city. After the war H. St. J. Philby, on a short visit, attempted to explore a part of the south wall but was stopped by King Hussein, and Sir Alexander Kennedy paid two long visits and published a book with a fine collection of photographs.

All these works had only a surface value and brought nothing to light which recorded the beginnings of the city. In 1928, the year after the country had become pacified under the British Mandate, the project for an excavation was discussed at the first Oriental Congress held since the war. In 1929 the Hon. Henry Mond formed the Mond (now Melchett) Exploration Fund and a small well-equipped expedition explored the site by making various soundings in April and May of that year; a short report of its work was published in the Geographical Journal for November, 1930, as a preliminary to the publication of a book at a later date.

Historically very little is known of Petra. Diodorus Siculus, transcribing from Hieronymus of Cardia, recounting the attacks made on it by the Greek Antigonus in 312 B.C., makes the first unambiguous mention of the city, and later historians add but few more details to our knowledge. Since the discovery in 1933 of Edomite pottery on top of the mountain Umm el-Biyara, dominating the present city site, we can identify this precipitous rock with the Edomite Sela of the Book of Kings and with the all-but-inaccessible acropolis of the Nabatæans, which was attacked by Antigonus. Taking its name from "Sela," the rock, the Hellenistic-Nabatæan city at its foot became "Petra." From Solomon's exploitation of the rich copper mines in the neighbourhood it had acquired a relation with the Exodus tradition; and here were located the spring of Moses (Ain Musa), Kadesh Meribah, and the tomb of Aaron (Jabal Haroun, Mount Hor), a tradition existing to-day as in the time of Josephus.

Plan of the "Conway High Place" at Petra.

Since the Melchett Expedition the exploration of the country has been

Shrine of the 2nd century A.D., with altar and votive pedestal, built against the south-west side of the older ring wall.

slowly going on and bringing to light relics of the Nabatæans as supplanters of the Edomites, yet inheritors of their tradition. They are revealed as a highly organised community, whose monuments have been confused with those of the Imperial Province by former explorers. It cannot be said even now that a full survey has been made of these ; but Dr. Nelson Glueck, late Director of the American School of Oriental Research, Jerusalem, joined forces with the Department of Antiquities, Government of Transjordan ; and, supplying funds and energy, pushed forward the exploration in 1933-34. The results of this survey have been edited by Dr. Glueck, and are now in the press ; the first volume will be published shortly.

One monument found by the Melchett Exploration Fund had baffled identification. Soundings on and around it had been made, and in the following years it was shown to various archæologists, who examined it with interest but reserved their opinion. It had been tentatively named the " Bronze Age Circle," and the Secretary of the Melchett Fund, with the approval of the Government of Transjordan, asked the Bronze Age expert, Dr. W. F. Albright, if he would excavate it. Dr. Albright accordingly organised a staff from the personnel of the American School and began work in December, 1934.

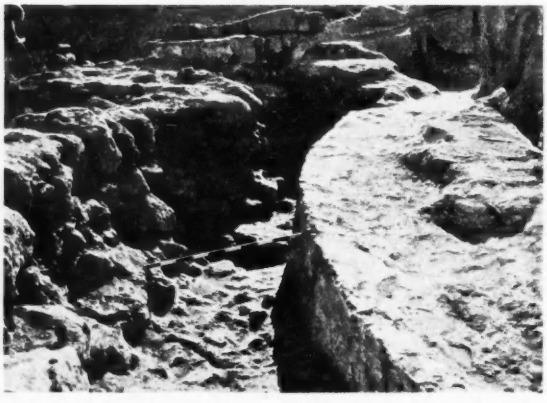
The monument is situated on the end of a high ridge and was within the N.W. angle of the city wall, now all but disappeared. It consists of a circular stone wall, $23\frac{1}{2}$ metres in diameter, built of coursed unhewn blocks of hard crystalline limestone known locally as *sinnam*, surrounding a low outcrop of red Nubian sandstone. On the west it is several courses high, whilst on the east it peters out against an extension of the rock. On top it was covered with a yellowish sand and from the middle stuck out a low shapeless mass of red rock, the common Nubian sandstone, contrasting with the limestone wall surrounding it.

Arab personal names identify the Nabatæans as an Arab tribe, though their documentary language is in the *lingua franca* of the day, Aramaic. Wellhausen and Lammens have collected evidence to show how prominent among pre-Islamic Arabs was the adoration of sacred stones, both portable and standing, by the method of ritual processions, known as *dawar* or *tawaf*. Wellhausen justly wrote that " the most important part of ancient Arabic cult was the procession around the sanctuary," whilst Lammens likewise stresses the dominant role in litholatry of processions in a state of nudity, though it is not known to what extent nudity was obligatory. A faint reflection of these pagan processions is preserved at Mecca in those around the Kaaba, and those around certain tombs of saints or *mezzar ;* though better instructed Moslems do not consider these seriously. Frequent attempts to find Hebrew analogies have so far proved unsuccessful, though quite possibly Canaanites and Israelites occasionally practised similar rites. Our High Place, therefore, goes back to a genuine Arab source. As it is located on the highest point of the city site, there is justification in regarding it as the earliest sanctuary yet found there, dating from the Hellenisation of the 4th century B.C., though this tentative date is supported by no ceramic evidence.

The remarkable semicircular rock-cut stairways on the south-west and north-east are probably contemporary with the earliest ring wall and processional way,

though this cannot be proved. In no case, however, are the former earlier than the latter. The stairways originally started at the same point, due south-east of the sacred rock. Leading to them from the south-east is a shallow passage with rock-cut steps, to which access seems to have been obtained by a flight of similar steps which approached the high place from the south-west, but was later destroyed in part. The photograph below illustrates the way in which the lower ledge of rock below the sacred rock proper has been cut away on the north-east to form the inner edge of the semi-circular stairway. While engaged in clearing the stairways, we expected them to pass under the sacred rock near its north-western end, and to meet in a grotto. This hope was disappointed, since both came to an abrupt stop against the north-west end of the sacred rock. The outer edge of the stairways was originally built up in part with masonry, nearly all of which was destroyed or removed in the course of later constructional activity in the high place, as will be seen. Since the stairways show at least one phase of partial filling and paving before the laying of the lower processional pavement (see below), we are justified in assuming a considerable period of use before the latter event, which took place about the beginning of the Christian era. Moreover, the original rock-cut steps of the stairways show signs of long or intense use before the earliest partial filling and paving, a fact which carries us back still farther. In other words, we are entirely warranted in pushing back the date of the original construction to the beginning of urban life at Petra, before the end of the 4th century B.C.

What was the purpose of these stairways? In our relative ignorance of the details of pagan Arab religion we can only surmise. However, we can hardly separate them from a chthonic cult of some kind—that is, they presumably served in connection with the cult of underworld fertility. That there was some such cult among the Nabatæans seems to be established by the evidence already existing for serpent worship at Petra and Ramm. Ritual entrances to the underworld were well known in antiquity, e.g., among Greeks and Babylonians (*nereb ersiti*, etc.). Nor should we forget the Holy Rock in Jerusalem, with the stairway leading under it. Whether the deity worshipped here was Dusares, chief god of the Nabatæans, or the mother-goddess—or another deity—escapes us at present. In any case Dusares was a god of fertility who was worshipped in the form of a stone cube.



Rock-cut trench on the east side of the Sacred Rock, forming a path for the semicircular stairway.

The next stage which we can establish in the history of our sanctuary was the laying of the lower pavement accompanied by the filling-in of the two stairways, which thus disappeared from the picture. Since stones and slabs of *sinnam* were used exlcusively in laying the pavement and raising the inner balustrades, which were set in the old stairways against their outer side, we are justified in supposing that the material was reused, and had belonged to a still older processional way. Between two stones from the foundation of the inner balustrade we found an ointment jug from about the beginning of the Christian era, carefully deposited as a foundation offering. Under the filling of the lower pavement was found a worn Nabatæan coin, imbedded in a matrix of hard yellow sand, so that its authenticity is certain; it seems to belong to Aretas III, c. 87-62 B.C. The buttress on the west belongs to the time of the lower pavement; its secondary character is illustrated by the fact that it is entirely built of sandstone.

The upper pavement was not so well laid as the lower pavement, and the surface is much more uneven; only part of it has been preserved. The same material—*sinnam* stone—was used. A much corroded Nabatæan coin was found in the filling between the two pavements. In the debris above and in the trench which we cut outside the ring wall were found numerous Nabatæan coins, though it was hard to distinguish between genuine finds and coins which had been "salted." On the whole it is probable that we erred on the side of safety, and that more genuine finds were rejected than the reverse. In any case, all of the rejected pieces but one were Nabatæan. Most of the legible coins belong to the reign of Aretas IV (*c.* 9 B.C.—40 A.D.) and his successor Malichus II (*c.* 40-75 A.D.). The upper pavement must almost certainly date from the late 1st century A.D.

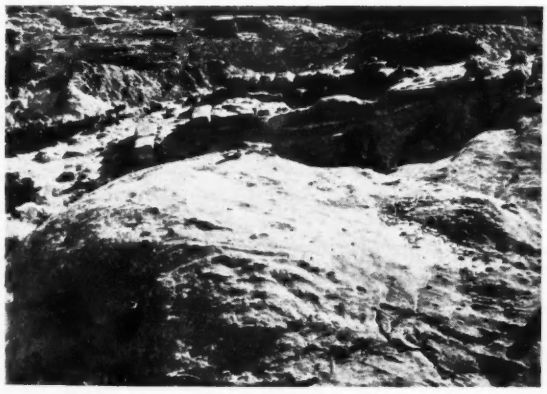
Probably contemporaneous with the laying of the lower pavement, or perhaps a little later, is the little shrine built against the ring wall on the south-west. Both the platform and the altar to the left are built of hewn sandstone. The pedestal on the right is shown

by the moulding to belong to the 2nd century A.D., according to Crowfoot and Horsfield. In any case it would have to be later than the altar. The pedestal may have supported a stela or a dedicatory inscription. In the debris of the High Place, inside the ring wall at the south-eastern end, we found a fragment of a marble dedicatory inscription in Greek, which may possibly belong in the shrine. It reads as follows :—

[ ]	ΜΟΛ (?)	[ ]
[ ]	ΚΑΙ ΤΑΛ (?)	[ ]
[ ]	ΟCΑ ΝΗΙ	[ ]
[ ]	ΑΝΟΝ Δ (?)	[ ]
[ ]	ΥΚΕ	[ ]
[ ]	Ε	[ ]

As will be seen it can hardly be anything but a dedicatory inscription, but its interpretation must be left to specialists in Roman epigraphy. The date cannot be later than the early 4th century, but the 2nd century is the most likely *a priori*.

In the 2nd and 3rd centuries A.D. the sanctuary within the ring wall fell gradually into ruin, though the shrine at the south-west continued in use. In this period the faithful were accustomed to bury pots of food inside the ring wall, evidently as votive offerings intended to ensure the recovery of members of the



The Sacred Rock, with the platform behind.

family from illness, etc. Since fifteen pots were found, almost all of them standing upright at various distances under the surface, there can be no doubt that a hole had been dug and the pot of food, provided with a lid, placed inside, after which the hole was covered. The lids are nearly always formed of a single large sherd belonging to a broken Nabatæan bowl of the delicate fabric now so familiar. Only one of the sherds had belonged to a painted Nabatæan bowl, but since this particular sherd was somewhat worn, it had evidently been picked up by the owner of the pot. Most of the pots belonged to the 2nd and 3rd centuries A.D., but two

Worn rock-cut steps in the trench on the west side of the Rock, dating probably from the 4th century B.C.

or three, found in the bottom of the south-west semicircular staircase (where sand was used as filling), are unmistakably earlier, and probably belong to the 1st century A.D.

The final stage of the history of the High Place is represented by remains of a conflagration which destroyed the south-west shrine and left a thick bed of sand mixed with ashes along the entire west side of the ring wall. The plaster with which the latter was once entirely covered is smoked and blackened for a considerable distance. Numerous building-stones of sandstone prove that the shrine was protected by walls. In this connection it may be observed that, as pointed out by Mr. and Mrs. Horsfield, the closest analogy to the latter phase of the south-west shrine is found in the sanctuary of Ramm which was recently excavated by the Dominicans, under Père Savignac's direction. The date of this sanctuary also seems to be the 2nd century A.D. The date of its destruction is fixed roughly by ribbed sherds of Roman type, bearing traces of the fire which had raged over them. These sherds are dated by Père Vincent in the 3rd or early 4th century A.D. ; in no case are they Byzantine, since the ribbing was done with the fingers, both the inside and the outside of the sherds having corresponding grooves.

Some of the preceding dates are later than those given by several of the scholars who have been consulted, so that any revision of our chronology must be upward not downward. Even with our most conservative chronology, however, we have a complex evolution covering at least five, and probably six centuries, from the first urban installation of the Nabatæans at Petra to the victory of Christianity. The monument is unique in its way, being probably the oldest sanctuary yet found at Petra, as well as a most interesting monument of pagan Arab cult.

The Kestrel Family.

By G. H. March-Phillipps.

The researches of the author into the intimate details of the life of British birds are well known, and here he has taken his life in his hands in order to secure information about that shy and beautiful hawk, the Kestrel. The description of his method of reaching the nest is as interesting as his observations on the nestlings themselves.

Of the three familiar English hawks—the Kestrel, the Sparrow Hawk, and the Merlin—the Kestrel is the most fascinating to watch. Its habit of hovering motionless except for the fine adjustment of wings and tail to air currents and eddies, is a masterpiece of aerial navigation. For minutes at a time it remains poised hundreds of feet above the ground, watching with an eye like a telescope for mice and voles in the grass beneath, until its prey is singled out and it dives like a plummet. A watcher with a pair of field glasses sees the long wings suddenly drawn in, and the lean body go whistling down with claws outstretched. The Sparrow Hawk shows none of this fine art ; his wings are shorter, and his method of flight is not so dainty. The Merlin flies low along the hedgerows, a system of attack known in falconry as raking, but in no way to be compared with the graceful hovering and matchless dive of the Kestrel. Nor is the Kestrel such a pest as he is often made out. Mice and voles form a large part of his diet, together with a few small song birds whose numbers are so large that they can readily be spared.

Last spring two Kestrels made their nest at the top of an enormous Scots Fir, close to where I was staying. To be precise they did not make their nest, they appropriated it. The jumbled collection of leaf mould and dead twigs had been the abode of pigeons for two or three seasons at least. The gamekeeper noted their arrival with anxiety. He regarded the Kestrel as a sworn enemy, and a disturber of the peace of his coverts.

The hatching of the brood. The first chick is quite dried off, the second just emerging from the egg.

But the owner had no such misgivings. He liked to hear them about, and, if by chance a few pheasant and partridge chicks were missed and the robbery was laid at the door of the Kestrel family, he comforted himself with the thought that chicks were only a question of pound notes, and Kestrels were not. So the new arrivals lived in peace.

At first sight the tree which they had chosen appeared unclimbable. It was a Scots Fir at least seventy feet in height, and only at the very top was there any succession of branches. At the end of one of these branches, about six feet from the stem of the tree, was the nest.

I spent half an hour with a pair of field glasses watching the two birds circling above their home. In spite of the fact that I was some distance away the hen bird never actually alighted, but continued her flight in big sweeping circles, occasionally pausing to " wivver " over the very top of the tree. The cock never ventured quite so close. All this time they kept up a weird, high-pitched cry, piercing and rather desolate, which brought to mind stretches of wild moorland, or giant cliffs by the sea. It was so fascinating that I resolved to watch the progress of this family from egg to fully-fledged bird.

How to Climb the Tree?

An expert with climbing irons would probably have run up the tree and down again in a matter of three or four minutes. But climbing irons are difficult to obtain, and by no means easy to use, so I determined to put an idea of my own into practice. I had thought of this idea some years ago in connection with climbing a beech tree to get at a rook's nest, but had never actually tried it out on account of the smoothness of the bark. Briefly it was this.

On a scaly, resinous tree such as a Scots Fir, which is covered with notches and the stumps of dead branches, there is any amount of friction to prevent a rope slipping if the two ends are held tightly. The idea was to use a piece of rope which would stretch about three-quarters of the way round the tree, with loops at each end to fit the climber's wrists. Thus in portions of the tree where there were no foot or hand holds, a purchase could be obtained simply by friction quite sufficient to hold the weight of a man, and the climber could work

his way up the tree using the rope as his main support, and his feet and legs as an aid. Where there were branches he could unloop the rope and continue without it, or use it simply as a safety device in the event of a branch breaking. The reason for having the rope round the wrists and not round the hands was to have the hands free to search for possible holds. For the descent (always the worst part of the climb) it is essential to reconnoitre the tree carefully and take a note of the worst snags likely to hook into the climber's belt, and to make constant use of the safety-rope.

The first climb was successful, but it was long and very arduous. I carried a small camera slung over my shoulder, and had my arms bare to the elbow, which last was extremely stupid as the rough bark played havoc with them. The rope galled horribly, and the effort required to work my way up the bare bole of the tree was terrific, but it was just possible. Once the strap of the camera got firmly wedged round a small dead branch, and I remained suspended on the rope, without being able to go up or down until the branch broke. And once, which was worse, a hand-hold snapped off short near the tree, just when I had thought myself safely over the worst and well among the stronger branches. But luckily my wrists were fastened round the bole of the tree as a safety precaution, and though my entire weight came with a jerk on the rope it slipped only a few inches.

The mother kestrel is here convicted of taking a song-bird as prey; but mice and voles are a more usual quarry.

The nest contained five speckled brown eggs, still warm, and delightful to handle and examine. Photography was no easy matter when swaying about at the end of a thin branch seventy feet above the ground, but once again the rope gave both moral and actual support. Placing it round the branch I thrust one of my arms through the two loops, and thus had both hands free to adjust and work the camera. One of the eggs was taken for a collection.

The family a week old. The last bird to hatch is quite hidden beneath the bodies of the rest.

During the next three weeks the nest was left severely alone. The hen bird was so shy that she would leave her eggs at the very faintest suspicion of danger, and might not return for an hour or more. Such birds are very likely to desert a nest if they are disturbed too much before their eggs are hatched.

At the end of three weeks I paid the nest another visit, and was lucky enough to arrive just as the young birds were hatching. One little fellow, a tiny ball of down with a head out of all proportion to his body, was exploring the nest in a clumsy series of flops, interspersed with many heavy falls over eggs and pieces of twig. Another was just emerging, working his tiny bedraggled body from the remnants of the eggshell. A third, to the accompaniment of a series of the most pathetic "peep-peeps" had only succeeded in pecking a tiny hole in the wall of his prison. I helped him by carefully picking away the broken pieces of shell round the hole. thus making a passage for his sharp little beak. The fourth egg was intact, but a very faint "peep-peep" could just be heard from within. I took a few quick photographs and hurried down the tree; a newly hatched chick of any description must have the warmth of its mother's body or it will die of cold.

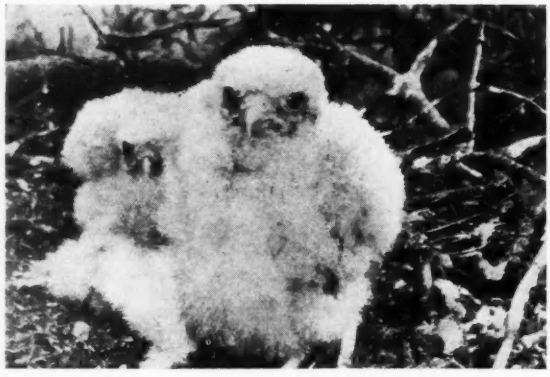
During the next few weeks I visited the nest frequently, and finally became so proficient in the use of the rope that I could climb the tree in just under two minutes. My first climb had taken me over five!

Anyone who has taken any real trouble in watching a family of young birds will understand the fatherly interest I soon began to feel for my Kestrel chicks. I grew to recognise them individually, and note their little peculiarities. The earliest arrival, he who had taken so many head-on falls on the occasion of my first visit, was

easily the largest and strongest of the family. He always sat on the right of his brothers and sisters, and would draw himself up with a great show of fierce pride as soon as my head appeared above the level of the nest. There was soon no mistaking in him the proud and dainty bearing of the Kestrel. The two middle ones never quite attained to his size and fierceness. And the last comer, the under bird, was pitiably weak. Unlike the others he had a habit of cheeping loudly whenever I appeared, and always crouched down in the bottom of the nest. One day I found his body on the ground beneath the tree.

But the remaining youngsters grew amazingly quickly. Very soon the remains of mice and the feathers of small song birds littered the nest, but I never actually saw the feathers of a pheasant or a partridge chick. This is not conclusive evidence that they did not take them, I know, but it may serve to show that they are not so bad as some people make out.

Each time I visited them it was like paying a call on a family of old friends. Gradually their plumage began to grow, and as likely as not I would find the largest and



The family at seventeen days. The first bird out was full of spirit and soon learnt to peck fiercely at the intruder.

strongest of the family perched proudly on the edge of the nest, where he would draw himself up and peck at me fiercely if I tried to touch him. Hitherto he had always been silent, but now he would break into a queer, high-pitched cry, a sure sign that he would soon be on the wing.

Then one day I climbed up to find the nest empty. All three had flown. With my glasses I searched the neighbouring tree-tops to see if they were roosting anywhere, but not a sign could I see. Doubtless the mother bird was already instructing them in the higher arts of flying in which the Kestrel Hawk excels.

Book of the Year.

THE scope of *Discovery* is so wide, and the quantity of volumes which nowadays come under review is so enormous, that the task of selecting one book as outstanding among the year's crop is as difficult as it appears invidious. But in choosing the last work of Sir J. Arthur Thomson* for notice here we are relieved of all anxiety on the latter score. It is not simply a case of *de mortuis* . . . ; the value of Thomson's work was as little in doubt when he was alive as it is now that he has finished with it. This last book of his stands out as a landmark in the popularisation of science among those who have not had the benefit of a scientific training; it is simply "a bundle of fitnesses"—to employ a phrase which the author often applies to the most successful biological types.

The first volume is occupied in its entirety by Book I, The Animal World: the second by Book II, Animal Life in General; Book III, The Plant World; and Book IV, Man. The chapters are divided into carefully arranged paragraphs with headings and important words or phrases emphasised by the use of heavy type, and each chapter contains one or more tables summing up, in a form convenient to the eye, the main conclusions to be drawn from it. Inherent in this form of exposition is the one fault that the work possesses—an amount of repetition rather annoying to the rapid reader; but no doubt this must be taken as a concession to the stumbling steps of Everyman, who knows nothing of biology.

Plentifully scattered throughout the book are short telling phrases, summing up the philosophy of science. The study of biology did not convert Thomson into a dryasdust laboratory man; on the contrary it filled him with a sense of the manifold wonder of Creation and inspired him with the desire to share this wonder with the uninitiated. With him there was no difficulty in reconciling science and religion; they were simply two aspects of the all-pervading—"Life is not for science," he writes, "science is for life."

This is not the place to catalogue the wonders of Nature. We only say: Read the book, and (in Thomson's own words) "begin thinking biologically . . . thinking of everything in the light of life. Our proposition is that biological science can render mankind great services. . . . Therefore let us have more biology."

Biology for Everyman has been admirably edited and seen through the press by Dr. E. J. Holmyard; the illustrations are really explanatory; and the production, appropriately simple, is a credit to the publishers

**Biology for Everyman.* By Sir J. ARTHUR THOMSON. (Dent, 2 vols., 15*s.*)

The Oxford University Arctic Expedition.

By Alexander R. Glen.
Leader of the Expedition.

Modern polar research has passed the stage of mere topographical exploration, and the Oxford University Expedition of 1935-36 has other aims besides the mapping out of the uncharted shores of North-East Land. Meteorological and physical work will include research on the ionosphere, which may have an important bearing on the behaviour of wireless radiations. The result of the experiments will be eagerly watched for.

THIS expedition, consisting of nine men, has received the financial support of the University of Oxford and of the Royal Geographical Society, and is leaving England in July to spend twelve months on the north coast of North-East Land. That country, which is about the size of Wales, lies between the islands of the Franz Joseph archipelago and West Spitsbergen, from which it is separated by the Hinlopen Strait. Mainly ice-covered, it presents a remarkable variety of glacial conditions, which, owing to the extreme difficulty of inland travel, explain the small degree in which it has been explored.

Nordenskiöld was the first to visit the interior in the course of a sledge journey, which he made in 1873 with Palander, on the sea ice along the north coast to longitude 26°E., where they were forced by the melting ice to return through the interior of North-East Land to their base in N.E. Spitsbergen. So hurried by necessity was this journey that little information was brought back, and it was not until the Merton College (Oxford) Expedition of 1923 sailed along part of the north coast that any further discoveries were made. In the following year three sledge parties of the Oxford University Arctic Expedition were at work in the interior, and the island was crossed for the first time. The Swedish-Norwegian 1931 Expedition carried out much valuable work, but the north and north-east coasts still remain virtually unknown.

The interior consists of three areas of highland ice, the summits of each of which rise to between 2,000 and 3,000 ft. The smallest of these covers the north-western part of the island, and is separated from the South Ice by Wahlenberg Bay, which with Rijps Bay almost cuts the island in two. An ice-free valley joining these two bays is fringed on the east by the low slopes of the East Ice, which, in its turn, is separated from the South Ice by a glaciated depression.

North-East Land is the objective of the new Oxford University Arctic Expedition of 1935-36.

The present expedition will consist of three surveyors, two physicists, a wireless operator, a geologist, a doctor-biologist, and a glaciologist. Two of the surveyors have had previous experience on Cambridge summer expeditions, and the leader has been on three Spitsbergen expeditions.

In order to transport the expedition to North-East Land, the sealer M.S. *Polar* of Tromsö has been chartered, and it is hoped that the north coast will be reached before the beginning of August. Heavy pack ice tends to make navigation on this coast difficult, but during the last few years conditions have been remarkably good. On reaching the north coast, the ship will make her way to Rijps Bay, where all the stores and equipment will be landed. Three men will begin building the base, which will consist of a three-roomed, double-walled hut. Two small huts also will have to be built, one for the magnetic instruments and the other for part of the wireless equipment to be used in the investigations on the ionosphere. As this part of the work, together with the

remainder of the physics programme, which will be under the direction of R. A. Hamilton, will be carried on continuously over the whole year, it will be best to describe it before proceeding to the exploratory work.

One of the most interesting subjects to be studied in the Arctic Circle is that of the atmospheric ozone. The "thickness" of the ozone layer was first measured by Fabry and Buisson in 1921 and was found to be about 0.3 mm.—that is, if all the ozone vertically above a certain area were isolated at atmospheric pressure it would form a layer 0.3 mm. thick. Subsequent work has been carried out by Dobson, Götz, Chalonge, and others. Cabannes and Dufay estimated the height of the layer to be 50 km., though recent records from high altitude balloons sent up by Regener show that a large amount of the ozone is very much lower. Ultra-violet light of wave-lengths between 2800 and 3300Å produce ozone from oxygen, but ozone is decomposed by ultra-violet light of wave-length about 1900Å. In early days it was believed that the atmospheric ozone was created by the action of the ultra-violet light from the sun, a state of equilibrium being set up between the producing and decomposing actions of the different wave-lengths. It was found, however, that whereas most stations had equal ozone values in the autumn, in spring the northern stations have much more ozone and show a rapid fall between May and June. The figures suggest, therefore, that the solar ultra-violet radiation is the chief decomposing agent, but that the ozone is created chiefly by atmospheric electrical discharges in the higher latitudes. It is, therefore, very important to measure the ozone thickness in the Arctic Circle. Experimental difficulties are considerable, as the sun is never high in the sky, and North-East Land is one of the cloudiest places in the world. In the winter, when there is no sun, we hope to measure the thickness of the ozone by observations on the Pole Star.

Researches on the ionosphere will be carried out for the first time north of the auroral belt. A decade ago it was not understood why wireless signals were heard at much greater distances than considerations of the curvature and attenuation of the earth would indicate. The theory was put forward that high in the atmosphere there existed a conducting layer, and that long-distance reception was due to the reflection by this layer of the waves which had been propagated upwards. The existence of this "Heaviside layer" was definitely proved by Appleton, Smith-Rose and Banfield, Breit, Tuve, and others: these investigations proved that reflections from a height of about 100 km. began about an hour before sunset and continued till shortly after sunrise. As it was clear that the sun is the ionising agent, it was supposed that in the daytime the atmosphere down to below 100 km. was ionised by the ultra-violet light of the sun, but that the wireless waves were absorbed in the lower ionised regions where the density is too great for reflection to take place (actually, of course, there is no sharp reflection but a gradual refraction). When, however, the ionising agent disappeared, this absorption was reduced owing to the recombination of the ions, and the waves were reflected by the regions at about 100 km. where the density is low enough for reflection to take place. A few years ago careful experiments by Appleton indicated the existence of a high ionised region, the "F layer." The ultra-violet light theory explains in general the observed phenomena of wireless transmission. In higher latitudes there are, however, occasions when no reflection takes place at all and as these occur at times of magnetic storms and auroral displays, it is supposed that the air is then ionised at a low level where absorption takes place. It will be recalled that in 1928 for a few days near the maximum of the magnetic storm 27-days cycle, no messages could be received from Nobile on the *Italia*. Observations were taken at Tromsö during the Polar Year, and some curious results obtained, but the layer 100 km. above Tromsö receives radiation from the sun once in 24 hours throughout the arctic winter; above North-East Land (Lat. 80°) this layer will be in the arctic winter and will be for some time uninfluenced by the ultra-violet radiation from the sun. Consequently these observations ought to be of the greatest interest.

A typical camp on the ice cap.

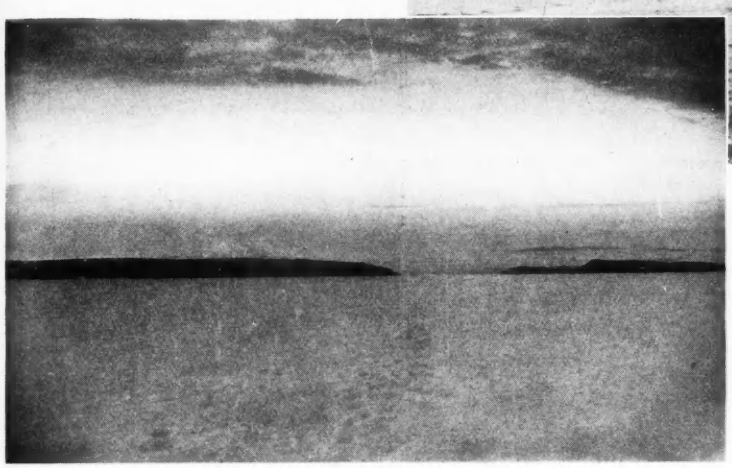
In conjunction with the work on the upper atmosphere routine observations will be made on the meteorological conditions, terrestrial magnetism, atmospheric electricity and auroræ. It is hoped that we shall be able to keep in wireless communication with England—the transmission being across the auroral belt.

In the course of the *Polar's* journey to Rijps Bay, if weather and ice conditions permit, a photographic reconnaissance of the coast between North Cape and Cape Platen will be made. When all the stores and equipment have been landed from the ship, the two surveyors, J. W. Wright and D. B. Keith, with the

geologist, will travel back to North Cape to survey this part of the coast, and to examine the geological structure. The former will be done by means of a theodolite framework, tied up by astronomical sights, and the detail will be filled in by plane-tabling. As summer sledging conditions are extremely bad, and as such a journey over this part of the coast would necessitate a considerable detour inland so as to avoid the crevassed surfaces of the lower glaciers, this journey will be made in the semi-decked whale boat which will be fitted with a "Seagull" outboard engine. Whenever possible, boat travel is the best method during the summer as it is both quicker and simpler than sledging, and the necessary journeys inland can be made, lightly laden, on skis. The greatest difficulty to be expected is through the pack ice being driven down on to the coast by a south wind, and in order to guard against this, a suitable block-and-tackle is essential in order that the boat may be hauled far enough up the shore to be safe from "rafting" ice. Fog is the main obstacle to summer survey, and if allowance be made for delays caused thereby, and also for the time taken in building survey cairns, it is probable that this party will not return to Rijps Bay before the first week in September. All glacier faces will be measured and marked so that they can be visited in the following year in order to discover whether they are advancing or retreating, and also whether there is any shrinkage, as appears likely in the case of several glaciers in West Spitsbergen.

In the meantime, once the hut and base have been completed, the remainder of the expedition will start to reconnoitre the best route to the summit of the West Ice, where a winter station will be maintained by two men. Between it and the base station in Rijps Bay, a second winter station will also be occupied by two men, and it is hoped that the route to these two stations will be marked with flagged snow cairns every quarter of a mile, and that most of the food and equipment for these stations will have been brought up to them by the middle of September. This will be done by dog-sledge journeys, and Greenland dogs will be brought for this purpose.

The object of these ice-cap stations is two-fold: firstly, to continue the glaciological work carried out by Professor Ahlmann on the Swedish-Norwegian 1931 Expedition, and secondly, to investigate the nature of the violent winds which sweep off the North-East Land ice caps. The glaciological observations have as their aim an interpretation of present glacial conditions, and the measurement of the gain and loss of the ice cap over the winter and spring and into the following summer. In order to do this, the various elements of precipitation, ablation, and thaw have to be measured with extreme accuracy, and not the least difficulty of the work lies in the design of suitable instruments. The action of the wind may be found to be one of the most important



(Above). Clouds settle rapidly in Spitsbergen and North-East Land; five minutes before this photograph was taken visibility was perfect.

(Left). The West Ice of North-East Land viewed from New Friesland in Spitsbergen. The Hinlopen Strait is covered by a continuous bank of low clouds.

factors of removal, and it is this factor which is most difficult to measure. Not only has the amount of snow removed by wind action during times of non-precipitation to be measured, but also the amount drifting from the surface as well as from the falling snow, during blizzards, must be estimated. In addition to this the small-scale structure of the ice will be examined with special reference to the crystal change undergone in the development of snow to névé, and finally to ice. The fact that it is very probable that the winds will be exceptionally violent renders the design of the winter stations difficult, especially as it is unlikely that it will be possible to use the snow for constructing snow-houses. The probable solution will lie in sinking a tent, similar in design to the one used by Courtauld in Greenland, flush with the surface of the ice, and in excavating storehouses and passages below the surface. The station will have to be adequately warmed and insulated, and the provision of paraffin heating stoves necessitates a system of ventilation which will provide sufficient escape for fumes, and which will allow enough fresh air to enter without unduly reducing the temperature.

The Lost Fjord.

Both stations will be relieved in the spring, but it may be desirable that one station should continue to be occupied until the summer, in order to carry on the glacial observations. When the journeys entailed by this have been finished, the two surveyors and ths geologist will sledge over the spring ice, conditione permitting, to Cape Leigh Smith, so as to explore and map the country lying to the east of Rijps Bay with especial reference to the limits of the ice. The journey may then be continued to Isis Point, in order to fix it astronomically, and finally to the south-east so as to discover whether the fjord described by Nordenskiöld exists, and if so, to map it. The return journey will probably be made over the East Ice, so as to examine its glacial structure.

As soon as ice conditions allow, boat journeys will be made to the eastern and northern islands, partly to survey them and partly to examine their bird life. The 1933 Oxford Arctic Expedition discovered that the kittiwakes and fulmars in the north-east of Ice Fjord in West Spitsbergen congregated from considerable distances to feed below the face of the Nordenskiöld Glacier off *Thyanoessa inermis*, which were indirectly able to swarm in this particular area owing to the silt layers brought down to the sea by glacial and glacio-fluvial streams. Glacier faces in North-East Land will be examined with especial reference to this question, and the influence of light and its variations throughout the year on the marine, and therefore, indirectly, on the bird life will be investigated. Finally the variation in character of the bird life from Spitsbergen to the east will be considered. This part of the work will be carried out by D. B. Keith, with the help of the biologist.

The programme is naturally controlled by weather and by ice conditions but the work has been planned on the lines indicated above. Extreme cold and strong winds will be the enemies during the winter, and fog and sea-ice during the summer. The success with which the plans are to be carried out must depend to a great extent on the degree in which these obstacles can be overcome, and that, in its turn, is to a great extent dependent on the organisation and equipment.

The ship will return during August, 1936, and will take the expedition and equipment aboard, either at Rijps Bay, or, if the sea-ice conditions make it impossible, at Wahlenberg Bay. Thus the expedition ought to return to England in September, 1936, but in case of accidents, full stores for two years will be taken.

A West African Waterfall.

Falls of the Cuemba, Angola, showing the prismatic form of the freshly broken rock. The scenery through which the Benguella Railway passes, and some remarkable geological phenomena, are described in the article which follows.

Laterite Formation in Angola.

By Malcolm Burr, D.Sc.

Dr. Burr's interesting sidelight on the geology of Africa is an excellent lesson on the principle that in natural science things are not always what they seem.

THE great sandy plateau of the interior of Angola is cut by a series of parallel dykes of an altered dolerite. A remarkable point about them is that this hard rock, running through friable incoherent sand, does not make a prominent feature in the scenery. The presence of the dykes may be recognised by the greater exuberance of the vegetation and the change from loose grey or red sand to a bright red ferruginous loam, with patches indurated with iron, weathering into pea-like globules. Where the dykes cut rivers, waterfalls are formed, often of striking beauty, but not visible from a distance, for, like most African falls, including the Victoria Falls, they seem simply to drop away into the earth.

Charming falls of this character occur at Kilo 781 on the Benguella Railway at a place variously spelt Cuemba, Coemba, Quemba, Cohemba, and Kohemba. The first spelling is now adopted and figures in the time-tables of the railway company. A quarry, one kilometre west of the falls, where the line passes through the outcrop in a deep cutting, was of great importance in the construction of the line as it is the only spot east of the Cuanza, at Kilo 724, where there is stone available.

The neighbourhood of the falls and quarry, especially the railway cutting, affords highly instructive examples of the process of laterisation of the rock. At the falls the water protects the rock from weathering, and in the view of the falls from below, prismatic blocks can be seen, broken from the face of the cliff with its vertical and horizontal joints. But where the rock is exposed to the disintegrating action of the weather, it wears not into prismatic, but into rounded surfaces, and in places big dome-like rocks are exposed which in appearance recall the ice-formed *roches moutonnées*. This is well seen in the illustration, where the joints also are clearly shown.

Dyke rock weathered in the form of a "roche moutonnée" at Cuemba, Angola.

A fine specimen of spherical decomposition of the dolerite rock in the cutting of the Benguella Railway.

The effect of this hummocky formation, due to the tendency to spherical weathering, produces a rather odd effect where the consequent laterite has been washed away. Often the clearing of the bush exposes a mass of boulders with the appearance of having been water-worn or rounded by ice. Indeed, in the case of these boulders we were tempted, quite wrongly, of course, to refer to them as *roches moutonnées*, while the rough, stony areas recall moraines.

The most striking case of this spherical tendency was in the railway cutting. Here is exposed a fresh vertical face of laterite some five to seven feet in height. Embedded in the red mass are several lumps of dark green dolerite, each about as big as a human head. Here we could see the whole process: the first stage is the breaking down of the felspar into white blotches with a tendency to creep along the cracks; the second stage is the creep of the ferruginous stain along the cracks; in the third the spherical form is clearly seen, showing an inner core of unaltered rock surrounded by thin, onion-like, concentric coats of half-decomposed rock stained with red; finally comes the formation of the pure laterite mass.

Dialectical Materialism.

By F. S. Marvin.

Mr. Marvin here reveals what few partisans of the theories of Marxism, more correctly known as Dialectical Materialism, are willing to admit : that all thinking which does not lead up to the cardinal proposition of the desirability of communism must be held, by good Marxists, to be dangerously biased. What such a system would lead to if applied to an exact science can well be imagined !

So many people are interested in the theory underlying recent events in Russia, and, of course, the whole world in the events themselves, that one must be thankful to the Society for Cultural Relations for organising a symposium on it and to Messrs. Watts & Co. for issuing the result in a little book.* Those reading it, however, must be prepared for some puzzlement. The only writer using the ordinary language and methods of philosophic thinking to which we are accustomed in this country, is Mr. E. F. Carritt of University College, Oxford, and those who find themselves in a fog at some earlier point in the essays would be well advised to turn to Mr. Carritt before they reach him in the ordinary course. It is in Mr. Carritt's essay that we find for the first time in the book the fundamental doctrine of Marx on which the whole structure of Dialectical Materialism is based—with, of course, the perverted Hegelianism which gives it a philosophical colour. Marx says, in his "Critique of Political Economy," that all social, legal, political, scientific, and artistic activities depend in general, and in the last analysis, on productive relations and these on the forces of production and these on the conditions of production. Mr. Carritt, who speaks as a Socialist, gives a very careful, and even a sympathetic, criticism of this fundamental doctrine. He admits—what is obvious—that our minds are affected or conditioned by the material world in many ways. The needs of the body occasion desires in the mind, and these desires will partly determine the objects I shall study, how I shall try to alter them, and the relations with other men into which I shall enter in doing it. He admits further that historians, in accounting for the development of beliefs and of social relationships and for the rise and fall of institutions, have largely underestimated the primary and constant influence of the relation between men's need for physical well-being and the means for its satisfaction.

An Impossible Doctrine.

Then he turns to criticism, and shows how impossible the Marx doctrine is, if we attempt to apply it strictly. It is true that men's views and activities are influenced by the forces and needs of production ; it is wholly untrue and absurd to say that they are entirely, or even mainly, determined by them. If they were, then, as Mr. Carritt says, every man in the same productive relations would do and think precisely the same things. There would be no such thing as truth. The doctrine is the narrowest and most perverted form of pragmatism, the most flagrant example of the danger of simplifying a mighty complex, of selecting one factor, which varies from man to man and day to day, as the sole determinant of a result, which is nothing less than the whole of human thought, man's conception of his universe built up in all the untold æons of the past.

When we put ourselves at this historical point of view and begin to realise its immensity, we feel that it would be nearer the truth to eliminate the Marxian factor of material production than to make all knowledge depend on it. The influence of material need for sustenance, fighting, and so forth, is rather the occasion of certain things being found out or learnt than the cause or basis of their truth. Men thus began to count, because they needed such accuracy in the division of the spoil or the preservation of their flocks. But mathematical truth is not conditioned by the hunger of men, and mathematics progressed much faster when men were not so hungry and could reflect more peaceably and continuously in the leisured society of Greece. Are we to say that Greek mathematics also were the product of a material and capitalistic society, as our dialectical materialists frequently assert of Newton ?

The Marxian Bludgeon.

The whole thing is a nightmare of confusion and darkness, due to grasping one prominent and insistent fact in the social environment of the thinkers and attempting to make it explain all the rest. It is one of the most conspicuous cases in the history of thought of the fallacy of over-simplification, being paralleled only by the other and larger Marxian dogma that "action and thought are identical." Here again one can put a tolerable sense into the formula by interpreting it, as Professor Levy does, to mean that thought and material changes are inseparable. It is true, of course, that all thinking involves some cerebral changes, but what has this to do with the full-blown doctrine of dialectical materialism, that, first, you have to accept the communist ideal that the community must own all the sources and means of

* *Aspects of Dialectical Materialism*, by various authors (Watts 5*s*.)

production and work them for its progressive profit, and that then, when this social ideal is accepted, all the science and philosophy of mankind will fit in naturally to it? The supposed connection is so fantastic that the normal mind staggers before it; yet this relation is accepted as a gospel by tens of thousands of ardent men and women and used as a rule, or a bludgeon, for tens of millions of others.

The social and political results of dialectical materialism have been discussed with a clamour and a passion which have filled the world for nearly twenty years. Less attention has been given to its effect on ways of thought, especially of historical and philosophical thought, of the acceptance of such crude attempted simplifications. One of these effects stands out conspicuous as a capital result of the plan of making abstract thought identical with, or directly determined by, the social and productive conditions of the time. It is this. One has, as a dialectical materialist, to accept the desirability or inevitableness of the communist solution of the social and industrial problem as a starting point. If one does not do this, all one's thinking is supposed to be biased in some adverse way which is generally called "capitalistic."

Thinking Backwards.

Now whatever these two systems "communistic" or "capitalistic" may mean, and whichever may be, in the abstract, preferable, we are, by this initial step, starting with the most advanced and complicated state of society and from that setting out to examine and explain the rest, including in it all the body of scientific truth which has been built up in the ages. This is to attempt to explain the simpler in the light of the most complicated and difficult, a method which would never be pursued by sane and truth-seeking men. We know, historically, that the truths of science have been acquired slowly and bit by bit, in a certain general order. If we include, as we should, the truths of mathematics among these, then it is true to say that the simpler parts of mathematics were laid down first, the simpler facts of astronomy and physics next, while chemistry, biology, and social science remained till much later, before their fundamental general facts were established. That this is the natural order of apprehension as well as of discovery is clear also from the universal practice of mankind in education. All men begin by teaching the young to count and measure, and, though we aim at arousing an interest and affection for living things by early concrete lessons in botany and natural history, no one would introduce early any teaching on the general facts, or laws, of biological science—genes, mutations, the relations of organism to environment, the rates of reproduction and so on. All are far more complicated than the mass movements of the heavenly bodies to which, outside his own immediate needs, man first applied his powers of calculation.

It is a true generalisation that the progress of thought has consisted in applying, more or less accurately, the methods of mathematics to more and more complicated things, and this truth indicates the natural order in which man grows in knowledge. It is the historical order, not the order of starting from an abstract ideal and then arguing downwards or backwards, to what the present *must* mean and what the past *must have been* to make the present. The vast majority of thinking men admit this with regard to their own approach to truth; only those, like the present rulers of Russia or of Germany, who have an urgent practical end in view, adopt the inverse method. But there is another—and quite practical—issue, which must occur to any one who surveys the progress of life—including human life—on this planet. Is it at all likely that either a communistic or a democratic or an autocratic form of ordering society and industry will become universal, or even general? The general law of life is increasing variety. This is to some extent counteracted in the case of men by the need of co-operation for mutual aid, and by the unification which has lately taken place owing to science. The world through this has become one and mankind now has means of acting and feeling together which it never possessed before. But that this involves the institution of similar methods of governing or arranging industrial production and distribution, is by no means clear. There are, in fact, many indications to the contrary. There is a growing number of smaller independent states, and, though on the whole the states of the world continue to preserve their taste for a nominally democratic form of government by elected representatives, there are now a prominent few who are content with a frankly autocratic rule. That it is possible actually to prefer this was clearly shown by the practically unanimous vote in the Saar on January 13th.

Unity in Diversity.

That there is room in the world for unlimited variety in government is obvious in itself, and actual in practice, as reference to any gazetteer of the British Empire will demonstrate. Union in diversity, or at least goodwill and the capacity for co-operation, are essential in the background; but, given this, the greater variety the better, just as the wise school or the wise family does not aim at turning out all its members identical. Co-operation and union are, in fact, both more interesting and more stable, if they can be secured at all, when the co-operating members in such union do

not each offer a precisely similar surface for contact. If one grants all this, even with some qualifications, what can appear more absurd or perverted than the attempt to link up human progress as a whole with one very difficult and entirely artificial and dictated form of industrial organisation? It is dictated by a theory, and the theory itself is based on a falsely abstracted reading of the facts of history. But human thought and the force of life are stronger than any theories which endeavour to encompass them. They will break through the meshes and fulfil themselves in many ways.

High-Speed Forestry.

By Our Special Correspondent.

A return on capital invested in forestry is not regarded as a rapid money-making proposition in England; but the important discovery of the accelerative action of the Australian climate on softwood trees has led to a great development of the industry there. Conifers reach maturity in ten or twelve years, thereupon becoming a readily marketable commodity.

THOSE familiar with the British landscape have lately become accustomed to the appearance of regular plantations of coniferous trees in country that for years has lain barren, a paradise for rabbits and moorland birds. From year to year scarcely any change in the size of the trees has been perceptible; but they do grow and in time will be of great service in replacing the wastage of the war years. He who plants trees in Britain, however, is planting for the future and for the increased value which afforestation gives to the land. In Australia, however, afforestation may be regarded as a genuine commercial investment, offering a good return on the capital invested within a comparatively small number of years.

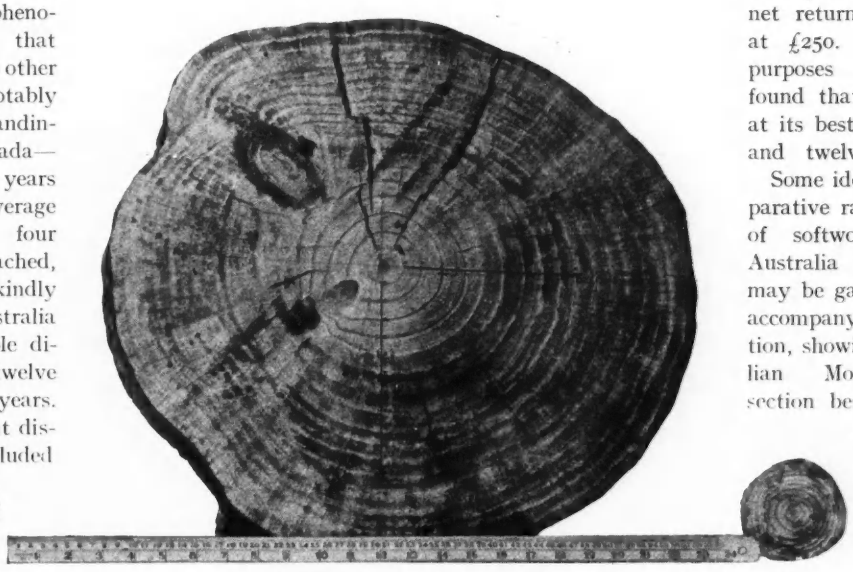
The Monterey Pine (*Pinus radiata*) is the tree that has proved most successful in Australia as a forestry product. The discovery of its rapid rate of growth and the original pioneer planting were due to the Australian Federal Government, while the development of this industry and its establishment on a commercial basis has been encouraged by the enterprise of the Forestry Pulp and Paper Co. of Australia, Limited.

Even the uninitiated cannot think of timber without marvelling that such a commodity can be partly responsible for our daily newspapers; the more well-informed person will think of artificial silk and numerous other uses. But how many will realise that the huge present-day demand for wood-pulp is making serious inroads into the world's supply and that it was not until comparatively recent years that anything was done to ensure that the supply would always be equal to the demand? Even to-day, the rate of planting coniferous

A plantation of Monterey Pines at Dartmoor, Victoria. The trees were planted in 1927 and the photograph taken in January, 1932.

trees is sufficient to stave off the threatened famine for only a very few years. Indeed, it falls so very far short of the required quota that the whole question of commercial afforestation has been the subject of close investigation by the Australian Government. The Institute of Science and Industry (the Australian Government Scientific Research Department) devoted their attention to it, and the findings created at the time the most profound impression.

Under actual test, this department, with its own acres of trees, proved the phenomenal fact that trees, which in other countries — notably Scotland, Scandinavia and Canada — took sixteen years to attain an average diameter of four inches, reached, under the kindly climate of Australia the remarkable dimensions of twelve inches in nine years. This important discovery was included in a report on the project of afforestation conducted by an official body at the request of the Government. And it swept away, in one stroke, the obstacle that hitherto had prevented the planting and growing of trees under commerical enterprise—the belief that the person who planted the trees did not live long enough to reap his reward.



A comparison of logs. The large section is from a Pinus radiata, *18 years old, cut at Dartmoor, Victoria. The smaller is from a 17-year-old larch grown in England.*

Like ourselves, Australians in the past have been obliged to import the vast bulk of their softwoods from overseas. While the country possesses hardwoods both of high value and excellent quality—such as Australian walnut, jarrah, black bean, Australian oak and silky oak—until a short time ago there was no softwood available for commercial use. In spite of this the consumption of softwood timber has always been extraordinarily high, and calculations have shown that per head of the population Australia uses more softwood than almost any other country.

To remedy this shortage, and with the object of building up a national industry, hitherto neglected, extensive areas have recently been planted by the Forestry Pulp and Paper Company of Australia in Western Victoria and Tasmania. The Company is run as a co-operative concern and presents an especially attractive investment at the present time. By subscribing £35 the investor becomes the owner of one acre of land. The Company undertakes to clear and plant the land, to tend and cultivate the trees while they are growing, and to cut and market them when they reach maturity. The number of trees planted to the acre averages 600, and the net return is estimated at £250. For pulping purposes it has been found that the wood is at its best between nine and twelve years old.

Some idea of the comparative rates of growth of softwood trees in Australia and England may be gained from the accompanying illustration, showing an Australian Monterey pine section beside a section of a larch, approximately as old, grown in England. In eleven years the Australian trees are as big as Canadian or Scottish trees sixty or seventy years old, and stand about eighty feet high. Timber experts have stated that such trees standing are each worth anything from £2 upwards according to accessibility, but in order to meet all contingencies, the Forestry Pulp and Paper Company has based its estimates on a gross return of only 12*s*. 6*d*. per tree.

In order to demonstrate that rapid growth does not tend to weakness, exhaustive tests have been conducted by Mr. R. W. Chapman, Professor of Engineering in the University of Adelaide. His findings were published by the Australian Federal Government (Woods and Forests Dept., Bulletin No. 1, 1928), and some pertinent extracts are given below :—

(1) Beam test (average of thirty-seven tests) :—

Modulus of rupture	7,027 lbs.
Modulus of elasticity	1,347,000 lbs.
Moisture	Under 15 per cent.

(2) Compression tests along the grain (average of sixty tests) :—

Ultimate compression strength ..	4,698 lbs./sq in.
Moisture content	Under 15 per cent.

(3) Compression tests across the grain (average of eight tests) :—

Load in lbs. per sq. inch :

To cause 3 per cent. compression ..	1,403 lbs.
To cause 15 per cent. compression ..	1,915 lbs.
Moisture content	Under 15 per cent.

As a comparison, tests were made with imported Oregon, the results of which were (average of ten tests) :

To cause 3 per cent. compression ..	1,244 lbs.
To cause 15 per cent. compression ..	1,425 lbs.
Moisture content	15 per cent.

(4) Resistance to shearing strength along the grain (average of forty-four tests) :—

Shearing strength in lbs. per sq. inch :

Perpendicular to rings	681 lbs.
Parallel to rings	712 lbs.
At 45 degrees to rings	859 lbs.

These tests prove that *Pinus radiata* is equal in strength to the majority of softwoods.

Adequate Rainfall.

The Forestry Pulp and Paper Company holds the freehold rights of nearly 8,000 acres at Dartmoor, West Victoria, of which over 6,600 acres have already been planted with *Pinus radiata* (now one to seven years old). In addition, there are eleven acres of nurseries stocked with seedlings and transplants for future operation. The average annual rainfall is thirty-two inches. At Pittwater, Tasmania, the Company's estate comprises over 3,000 acres, of which 2,320 are already planted with the same kind of trees as at Dartmoor. This estate is eleven miles east of Hobart and within forty miles by river (an excellent means of transport) of the great fruit-growing district of Huon, which uses annually over twenty-five million superficial feet of timber for making cases for the export of apples.

Adequate firebreaks are provided on both estates, and roads, many of which are metalled, are already in existence. Needless to say, such roads, because they are kept clear, constitute in themselves excellent firebreaks. The actual planted area is securely fenced with rabbit-proof netting. The land actually held by the Company is sufficient to allow for very extensive yearly plantings up to a period of ten years, and another plantation was started only last year on the south side of Bruny Island, Tasmania.

Full details as to the Company's properties and their interesting scheme of co-operative forestry investment may be obtained by applying to the Forestry Pulp & Paper Company of Australia, Limited, Bush House, Aldwych, London, W.C.2.

Correspondence.

To the Editor of DISCOVERY.

OBJECTIVE AND SUBJECTIVE REALITY.

Sir,

Mr. R. W. Kidner's interesting letter in your January number rightly insists on a more quantitative presentment of the data. But I had been chiefly concerned with the qualitative statement of a relationship which seemed to exist between the Subjective and the Objective. This is why I ignored the obvious pivoting movement actually required to observe the reflected image from O_2.

As Mr. Kidner shows, this subjective movement should be stated in comparable terms with that necessary to pass from O_2 to O_1. Therefore, he suggests that the latter, by the justifiable often-applied objective devices he mentions, be reduced to a pivoting movement, and the variation in degree of pivoting shown, from case to case.

I think an even more exact common standard of comparison would be provided if the axiom were applied that all subjective movements should be assessed from a plane in which the eyes rested, parallel and at close proximity, in every instance, to the plane of the word-object viewed (optical images, in this context, being called objects). Thus, from position O_2 to O_1 the movement of the body of the observer would be through approximately 360°, if the glass were of negligible thickness, and from O_2 to view the reflection, through but 90°. The subjective movement difference would, therefore, be 270° to see similar images of the same optical object, differently produced objectively.

There need even be no preliminary pivoting as regards the larger subjective effect, for the observer, after being at a great enough distance from the plane of O_2 to cause the plane of his eyes to vary by a negligible angle from parallelism to the former plane, could walk straight forward at right angles to the glass, across the origin made by his path-line with the glass-plane, on to a point an equal distance from O_1. But, even then, he would have to pivot his body completely through 180° to observe O_1. In this case, to the subjective effort involved in walking this distance would be added the subjective effort of pivoting through 180°, and the subjective effort involved in the possible use of a telescope to read the word. Since, in the way above suggested for a comparable standard, complete movement through 360° from O_1 to O_2 is required, then the effort required for the distance walked in this latter alternative way (supposing a telescope unnecessary) would be approximately equal to 360—180=180°, minus the effort of moving through the smallest practicable arc of 360°. This seems to bring together strange incompatible bedfellows, but the point is that, whichever way it is looked at, there is, starting from a common base line for the Objective and Subjective aspects, a large difference in subjective movements resonating to an apparent identity in objective effects.

And, like the case of the moon, which projects a great effect subjectively, whilst at the same time denying such an effect objectively, this quantitative lack of congruence seems somehow to be a function of the inter-relationship of the Subjective and Objective.

Yours faithfully,

S. C. BLACKTIN.

Denton Avenue,
Roundhay,
Leeds, 8.

Grainiess in Photographic Negatives.

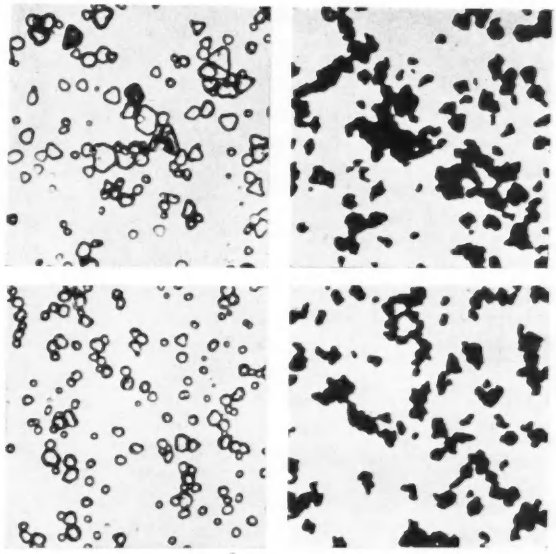
By Olaf F. Bloch.

With the advance of technique in photography, chemists have been concentrating upon the improvement of photographic material. Mr. Bloch, as chief of the Research Laboratory of Ilford, Ltd., is in close touch with the progress made; he gives here an interesting account of a problem which is important to modern photographers.

In these days of the small precision camera and the kinematograph, the question of the size and condition of the grain of a developed photographic emulsion has become of considerable importance. In the case of the small camera, all the negatives which are to be made use of must be enlarged, sometimes considerably, and this applies also to many negatives used for advertising purposes and press illustrations, whilst in the picture theatre an enlargement of from 150-200 times is not uncommon.

Silver bromide crystals held in suspension in gelatine form the sensitive material of a photographic emulsion, and these can vary greatly in size and shape. Generally, the more sensitive to light the emulsion the greater the proportion of large crystals which it contains, and these are by no means uniform in any one emulsion. An average grain size of 0.1μ (1μ = 1/1000 mm.) obtains in the finest grained lantern emulsions, whilst fast portrait emulsions may average as much as 1.2μ. These grains may be in the form of flattened plates, or they may be more or less spherical in shape with many intermediate forms. In the older types there was a wide variation of crystal grain size in one and the same emulsion. With recent progress in the art of emulsion making it has been found possible to prepare more evenly grained emulsions with a lower average crystal size and comparatively free from clumping. Clumping is the term applied to a cluster of crystals in contact with one another. If acted upon by light these develop as a single unit and thus tend to give coarser grained emulsions. In addition, any two grains which touch one another will develop as a single grain even though only one of them has been affected by the exposure. Further, the grains increase in size upon development, and if, in consequence, contact be made with another crystal, this becomes infected and develops also; thus a grain larger than the original is the result. Variously compounded developers have been devised with a view to securing finer grain in the negative. These are, in general, slow acting and, therefore, when the plate is removed from the developer it generally has a lower contrast (gamma) than if it had been normally developed. If it had been kept in the modified developer until it reached the same degree of contrast, then there would be found to have been but small difference in graininess between the two.

Graininess is largely a physiological effect since its importance lies in the extent to which it interferes with the visual aspect of the positive. Therefore, it is not possible to set up an absolute standard of measurement.

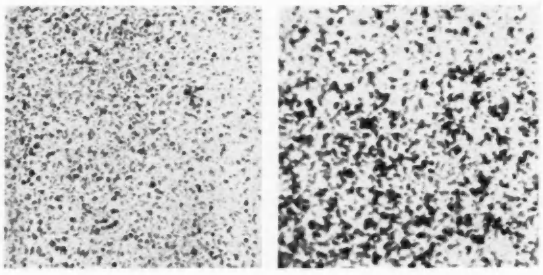


Ultra-Rapid Emulsions (× 2500)

Undeveloped.	*Developed.*
Old type: average grain size 1.15μ.	*Old type: relative graininess* 13.0.
New type: average grain size: 0.72μ.	*New type: relative graininess* 5.5.

Graininess might be defined as the distance at which the image of the silver deposit no longer appears uniform at constant magnification, or the magnification at which the silver deposit no longer appears uniform viewed from a constant distance. Various methods have been employed for measuring this property. One of the most interesting of these is to obtain a microphotometer record of the density of an evenly exposed and developed plate. The record is not a straight line, but a wavy one, rising above and falling below the horizontal. The deviations are a measure of the graininess of the emulsion, but, unfortunately, the readings vary with the slit width of the instrument, and it would, therefore, be necessary to specify a standard slit width. Another

method consists in measuring the density of the negative by means of both parallel and diffused light. When these two are plotted against one another, figures can be obtained which approximate to the relative graininess



Lantern Emulsion (× 2500).
*Undeveloped : average *grain size* 0.10μ. *Developed : relative graininess approx.* 1.

over a portion of the curve, but this appears to be due to a coincidence rather than to any underlying principle. Other methods include those of matching the projected and enlarged image of the grains against a standard, the magnification being changed until a match is obtained.

Though all these modes of determining graininess give results which are comparative in character, they have been of considerable assistance to those engaged in improving our photographic materials in this direction.

Science History School.

Good work, with the object of studying the various branches of science, and correlating them with other departments of learning, has been done in the past by the Unity History School; and during the fortnight around Easter this year (April 13th-27th) the School is holding its thirteenth meeting at the University of Rome, by the invitation of the School of History of Science in that city, of which Professor Enriques is president.

The meeting will be in charge of Professor Enriques, Mr. F. S. Marvin, and Dr. W. Alfred Parr, each of whom will deliver a lecture during its course, Mr. Marvin dealing with "Science and the Unity of Mankind," Dr. Parr with "Present-day Views in Astronomical Research." They will be supported by many distinguished savants, including Professor Herbert Dingle and Dr. Desch. Members of the School will be allowed plenty of time for seeing the sights of Rome and its neighbourhood, which are at their best at Easter.

**Grains too small to be resolvable.*

The Ancient East.

Ancient Egypt and the East, issued by the British School of Archæology in Egypt (7*s.* yearly), has recently produced its winter number (Macmillan, 4*s.*). Now that its founder, Sir Flinders Petrie, spends most of the year in Palestine and Syria, the editorship is in the joint charge of Dr. Margaret Murray and Mrs. D. Mackay, and the scope of its two half-yearly numbers has been widened to include the archæology of the whole of the East. The present number is, as a matter of fact, almost exclusively devoted to Egyptian matters, but some very interesting comparisons with other near-Eastern cultures are made in Mr. H. C. Beck's paper on Glazed Steatite Stones (which includes a very careful analysis of the materials used and some fine photographs of microscopic sections) and in Mr. A. Lucas's article on Artificial Eyes. It does not so far appear, in spite of the varied and beautiful technique of many of the eyes for statuary, that artificial eyes were ever made for the living. Dr. Murray's short paper on the "foreign" god 'Ash credits this three-headed demon of hyperborean origin with a longer literary history than any supernatural being so far recorded, extending from the IInd dynasty to the 16th century of our era. The resemblances between the German print of 1545 and the coffin-painting of the XXVIth dynasty, style for style, are most striking.

We should have welcomed an illustrated article on the last six months' work on some or any of the sites in Palestine and Syria, but allowance must be made for the pressure of space, and no doubt the next issue will give adequate place to the season's excavation there.

Tell Duweir.

A recent cable from Sir Charles Marston reveals the interesting progress made by the Wellcome Archæological Expedition to the Near East at Tell Duweir (Lachish). Ten potsherds bearing Hebrew inscriptions written in ink have been found in late-Jewish levels, which cannot be later than 588 B.C. In addition to the divine name Jahve, which appears several times, the names Jeremiah, Mattaniah, Gemariah, and Jaazaniah occur. The writing resembles the Samaritan Pentateuch. The use of ink, and the occurrence of the name Jahve at this early date are of the greatest significance.

Photographic Progress.

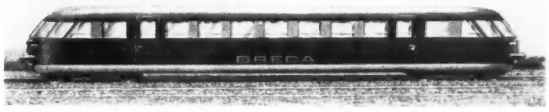
The Progress Medal of the Royal Photographic Society has been awarded to Harold Dennis Taylor in recognition of his Inventions, Researches and Publications in Optical Science, which have resulted in important advances in the construction of Photographic Lenses and in the Development of Photography.

Rail Transport Developments.

By Major A. P. Le M. Sinkinson

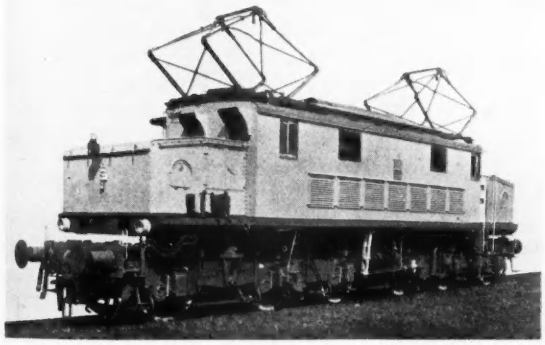
In the issue of *Discovery* for November, 1934, the article "Travelling Light" dealt with some modern developments in railcars. The Diesel railcar serves a dual purpose. It may be used to supplement the ordinary service of steam-hauled express trains in the way so strikingly exemplified in Germany, or it may be used for local services on branch lines. The Diesel locomotive has many uses besides, which need not be detailed here. The problem of the unremunerative branch or secondary line has kept more than one traffic manager awake at nights. Before the popularisation of the motor bus country people were obliged to use branch railways if they wanted to move about, unless they were carriage folk or cyclists. Now that almost every village in Great Britain is served by one or more motor-bus routes the local inhabitants usually find the road more convenient than the railway for short distances, and branch trains are becoming deserted. How, it may be asked, have the railways reacted to this new situation? The directors, instead of strengthening and speeding up the services on branch lines, have continued to offer the kind of service which did duty before the motor-bus was heard of. When the inevitable happened and the trains began to lose custom, the only policy that occurred to the managements was to surrender to the motor-bus companies and to close down branch after branch. It is true that some of these branches are still open for freight traffic, but the railways have made a present to the motor-bus companies of such passenger traffic as they did manage to retain, salving their troubled consciences with the thought that they are financially interested in their rivals.

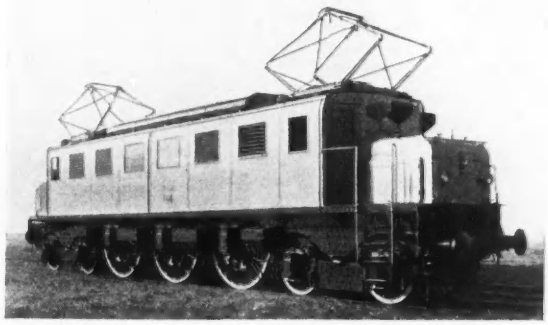
A much more enlightened method would be to organise an intensive service of Diesel railcars on unremunerative branches. Such cars, with their well-known accelerative powers, would be able to run at average speeds of 45-50 miles an hour, including frequent stops, as against the 25-30 miles an hour of the stopping steam train. Instead of trains running at infrequent intervals, there should be a service of railcars every 15 or 30 minutes, or even oftener. Since, owing to the stupidity of our forefathers, railway stations are often a mile or more from the centre of a town, it might be advisable for the railway companies, now that they are allowed to use the roads, to run local motor-bus services to and from their country stations.



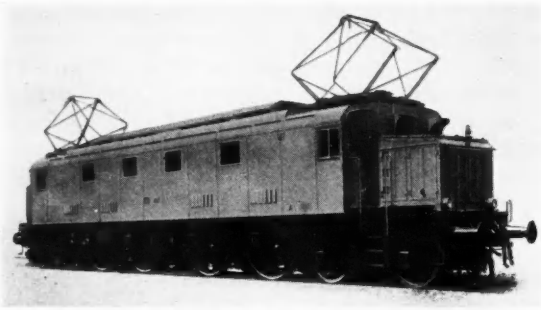
Diesel railcar for service on Italian railways.

In some Continental countries the railway managements have counter-attacked, instead of surrendering to the competition of the roads. In Italy especially railcars have been introduced with the express purpose of meeting the challenge of the road to secondary and branch line railways. The administration of the Italian State Railways has adopted for use on its standard gauge lines a type of Diesel railcar built by the Società Anonima Italiana Ernesto Breda of Milan. This car has two engines with a total horse-power of 260 and a maximum speed of 140 km. (87 miles) an hour. The overall length of the car, which is carried on two four-wheeled bogies, is 69 ft. 8½ in., the seating capacity 56, and the weight 20 tons. With a carrying capacity (passengers, staff, stores, and baggage) of 8 tons, the





Two types of electric locomotive for use on the Italian State Railways. That on the left, for ordinary service, has a maximum speed of 90 km. an hour and weighs 90 tons. The express locomotive on the right weighs 112 tons and attains a speed of 130 km. an hour.



A specially heavy express locomotive (128 tons) made for the Italian State Railways by the Breda Company.

weight per passenger, fully laden, is exactly half a ton—a figure even better than that of the Flying Hamburger, which was one of the first modes of rail transport to exemplify a favourable passenger-weight ratio. For the numerous privately-owned railways in Italy, many of them of narrow gauge, three different types of railcar have been built. The smallest, for both standard (4 ft. 9 in.; Continental standard) and narrow (3 ft. 1½ in.) gauges, is a light four-wheeled vehicle of 9 tons, driven by a 100 h.p. engine with a top speed of 80 km. (49.7 miles) an hour. There are 36 seats, the carrying capacity is 4 tons, and the weight per passenger 0.36 ton. A larger type, for standard gauge, runs on two bogies, and has an engine of 130 h.p., with a maximum speed of 100 mk. (62.1 miles) an hour. Its weight is 20 tons, its carrying capacity 8 tons, and there are 90 seats, so that the weight per passenger is 0.31 ton. An articulated two-car unit on three bogies for narrow gauge has an engine of 100 h.p., with a top speed of 60 km. (37.3 miles) an hour. The weight and carrying capacity are 21 and 10 tons respectively, and the passenger accommodation 84. The passenger-weight ratio is 0.37 ton. The all-electric railcar is not unknown in Italy, a number having been built for the Ferrovia del Gargano and other railways. It is doubtful, however, if such a vehicle can be regarded as a serious rival to the Diesel or petrol-electric railcar, owing to the enormous cost of equipping the track for its use.

Heavy electric locomotives are still being built in Italy in connection with the programme of railway electrification, and some interesting and powerful types have recently been delivered by the Breda Company for standard gauge. The most powerful has eight motors, developing 4,000 h.p., with a maximum speed of 130 km. (80.7 miles) an hour. Its length is 62½ ft., and it weighs 128 tons, with an adhesion weight of 80 tons. A rather less powerful locomotive, of 3,000 h.p. (six motors), has a similar maximum speed, but weighs 112 tons, of which 66 tons are available for adhesion. A third type, likewise of 3,000 h.p. (six motors), weighs 90 tons, and has a top speed of 90 km. (55.9 miles) an hour.

In Germany the success of the Flying Hamburger has led to the multiplication of railcar services in different parts of the country. Next May the Flying Frankfurter will run from Berlin to Frankfurt in 5 hours at an average speed of about 68 miles an hour, including several stops. This is approximately three hours faster than the fastest steam train. Other express railcar services to be introduced in May are from Berlin to Cologne, Dresden, Leipzig, and Königsberg, and from Cologne to Hamburg. For these new services two-car units similar to those on the Flying Hamburger will be generally used, but a few three-car units, accommodating about 150 passengers, are to be introduced as well. The example of Germany might well be followed in this country. Fast railcar services from London to Aberdeen, Perth, Inverness, and other places in the north of Scotland would be greatly appreciated.

Regional Surveys.

THE Administrative Council of the Le Play Society has an interesting programme for the Easter Vacation. Under the leadership of Mr. H. S. Williamson, Principal of the Chelsea School of Art, and with Mrs. H. V. Lanchester as hostess, a party is to leave London for Spain on April 6th. From Madrid a journey south will be made by touring car. Another party is to go to the Apennines. Dr. G. Furlong, Lecturer at the National Gallery, will lead, and the hostess will be Miss Margaret Tatton. From Florence the group will go by motor to Arezzo, Perugia, Rimini, and Ravenna, by way of Gubbio, Urbino, and San Marino. Regional Survey work at home is to be undertaken in Ipswich and its neighbourhood, under the guidance of Mr. George Morris and Mr. Guy Maynard, Curator of the Ipswich Museum; also in the Cotswolds, Miss Charlotte Simpson, having a special Training Course at Cranham. Those interested in either of these activities should write to Miss M. Tatton, Director, 58, Gordon Square, London, W.C.1.

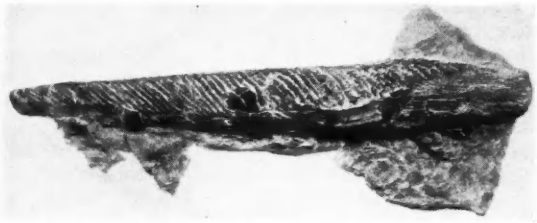
Some idea of the quality of the work to be carried out by the Society may be derived from their recent publication on *Les Eyzies and District*, though this, of course, deals with a totally distinct aspect of civilisation. The pamphlet, however, is by no means simply an archæological tract, but presents a general survey in which human settlement and occupations are related to their natural setting. Many of the workers who helped in the compilation were non-specialists, which should be an encouragement to newcomers thinking of embarking on this fascinating form of holiday task.

Some Fishes of the Past.

By Henry H. Simpson.

CONSIDERABLE interest is being taken, by that section of the public devoted to sport, in certain living fishes of to-day. Some are pursuing the thousand-pound tunny with curious and complicated tackle, while others have recently been observing or trying to observe the elusive "monster" of Loch Ness, which may or may not be a fish. A milder form of excitement is that indulged in by a few knights of the hammer, who are patiently endeavouring to tear from the rocks the story of fishes of the past.

Our first illustration shows the fin spine of a fossil fish which undoubtedly inhabited our waters in Upper Coal Measure times, maybe in the region of two hundred

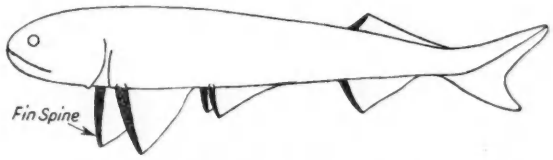


Fin-spine of Gyracanthus, *from the Ruabon Marl, about one-third natural size.*

million years ago. The next is a restoration of a similar complete fish, showing how the spine illustrated formed a cutwater, as it were, for the fin, at the same time offering support, in a fashion not unlike the mast of a lug sail. The fish may have been from six feet to eight feet long, and somewhat resembled the shark. Very likely its natural home was the open sea or estuarine waters and no doubt it lived on smaller fishes. The fossil was dug out of the red Ruabon Marl of North Wales, a fine-grained hardened mud, each little grain coated with red oxide of iron, a deposit, in fact, similar to some lake muds which are being formed to-day.

The question naturally arises how such a marine fish came to be living in an inland lake. The answer is to be found in the marl itself. At and above the place where the fossil lay the marl has turned in colour to a blue-grey, but after a few inches of this, the colour becomes red again. The inference is that something occurred which brought in this and similar fishes and changed the colour. The most reasonable explanation is that the sea broke through the low-lying barriers of the inland lake, for a short time only, but long enough to allow fishes to become fairly numerous, as the fossil illustrated is only one among many such dug up.

A rather curious fact in connection with these fishes is that so far their remains have been found at only one place in the quarry, and it appears as if they had been overtaken by some disaster at the bottom of a shallowing pool. The same sort of thing has been noted



Acanthodes Wardi, *a Coal Measure fish resembling* Gyracanthus ($\times \frac{1}{6}$; *after Dean*).

by Hugh Miller in connection with the Old Red Sandstone fishes of the North of Scotland.

Associated with these spines and the accompanying fins part of the palatal plate and the ribs of a lung-fish have been found, very like those of the present-day mud fishes of Australia. The palatal plate in question shows no appearance of wear, and such a condition may be due to the food having consisted of soft vegetation. A diet of shellfish or vegetation contaminated by sand would undoubtedly lead to the wearing of the sharp ridges of the plate. Shellfish, however, are not found in the Ruabon Marl and sand is absent at this particular horizon.

Fossils turn up sometimes in most unexpected places. The writer remembers being handed a part of a spine, similar to the one illustrated, which had been delivered with a load of coal from a Denbighshire pit. Very likely it came from the roof of the coal seam, for authentic instances of fish remains in the coal itself are very rare indeed. In spite of the apparent difficulties in the way of tracing the exact horizon from which it came, it was found possible to locate its position very nearly through the characteristics of the coal delivered with it. As far as can be discovered it is the only known specimen of such a spine from the Middle Coal Measures of North Wales.

Unfortunately, our knowledge of the distribution and habits of the Coal Measure fishes is not very complete, so that their presence in the shales does not tell us very much. It is difficult, for instance, to say that a certain fish is marine, as it may have been like the salmon, sometimes in the open sea, at others in rivers. One instance, however, of the use of fossil fishes may be cited from North Wales. Above a particular seam of coal there is a narrow band containing innumerable fragments of the hard parts of fishes, in fact, a fish bed, and the presence of this is a sure indication of the horizon of the coal associated with it.

Book Reviews.

Combustion from Heracleitos to Lavoisier. By JOSHUA C. GREGORY. (Edward Arnold. 10*s.* 6*d.*)

This is a type of book of which there are all too few. In these utilitarian days the historical, one might almost say, the romantic aspect of science is strangely neglected. Perhaps many scientific men are too busy or too highly specialised to pay adequate attention to the growth and historical development of their subjects. It must not be forgotten, however, that this particular method of presentation has a most valuable teaching function. Mr. Gregory has taken pains with his subject and has made a very readable story out of it. At the same time he has contrived to incorporate a considerable amount of scientific information dealing with the physical and chemical concomitants of combustion.

It is inevitable that a large part of the book is concerned with the general historical development of scientific ideas. Mr. Gregory starts with the early systems of philosophy and proceeds to the modern experimental methods as exemplified by Lavoisier. The fragmentary details which have come down to us indicate clearly that the philosophy of that rugged Ionian philosopher often spoken of as "Heracleitos the Obscure" was bound up with a central idea of eternal flux. His ultimate principle seems to have been that all existence is resolvable into fire—the world arose from fire and is resolved into fire. From this theme the author conducts us by a most interesting commentary through the phase of the Aristotelian "elements" and the Cartesian Conventions to the emergence of the dominating phlogiston conception which proved so obstinate and fixed until comparatively recent times.

Some of the chapters are particularly worthy of mention, such as that on the "Augmented Calx" and "Fire, Phlogiston, and the Calx."

The latter part of the book, which is devoted to modern development, is good and contains useful historical information carefully put together; it presents a graphic picture of the gradual evolution of the modern scientific view of combustion.

The book can be confidently recommended to all who are interested in the history of science and particularly to students who will find in it a pleasant stimulus and a useful help in revision of their work.

Birds of Great Britain and their Natural History. By W. P. PYCRAFT. (Williams and Norgate. 7*s.* 6*d.*)

An ornithologist "of some standing" once told Mr. Pycraft that "we know all there is to know about British birds"! No one can read a chapter of this book without realising how many gaps there are in our present knowledge. For instance, do owls find their prey by sight or sound or both? Why is it that the brown owl has the aperture of the right ear larger than that of the left, and that in some other owls we find aural asymmetry? Why do guillemots and razorbills use their wings as propellers when under water while cormorants and other diving birds use the feet and keep the wings close to the body? What determines the localisation of the coloured areas in different species—the varying red patches on the woodpeckers or the black stripe through the eye in, e.g., the blue-tit, red-backed shrike, and nuthatch? These, and a hundred other questions raised by Mr. Pycraft, are still unanswered; many of them are likely to remain so until more field ornithologists are willing to emulate such patient and careful research as that recently undertaken by Col. and Mrs. Ryves with regard to the corn bunting, which they have discovered and proved to be polygamous.

A glance at the chapter headings shows the width and breadth of this book: e.g., Protective Coloration, Territory, Courtship, Juvenile Plumage, Migration, Classification. On all these subjects the author has either something to say or to present in a new light. Some of his theories may be questioned by experts. But this book will be useful to the numerous and increasing company of those who have a considerable knowledge of our birds but wish to know more about the trend of modern scientific ornithology and the problems which it is attempting to solve. They will find Mr. Pycraft a reliable and stimulating guide.

His views about the egg collector pest are emphatic. "There are collectors who know nothing, and care less, about the *problems* presented by eggs . . . the summit of attainable satisfaction is reached if they can . . . possess themselves of 'the last egg of that species' laid in Great Britain. . . . One man I knew of, since happily dead, reputed to be a 'great ornithologist,' raided the last known breeding colony of the Red-necked Phalarope in Ireland; took every egg he could lay his hands on, and shot every bird he could see, in order that he might show in his cabinets 'the last eggs of the Red-necked Phalarope in Ireland.'" As he says of another piece of vandalism "The Man of Science has no use for such ill-gotten spoils." It is refreshing to hear such sound views expressed so vigorously by a scientific naturalist: the collecting of British birds' eggs may at one time have had some excuse, but its utilitarian days are ended: its aims and methods are out of date. What the enlightened field naturalist studies now is the behaviour of the live bird, in courtship, in incubation, in the rearing of the young, and on migration: all of these are far more important fields of research than the furtive and illegal acquisition of eggs whose characteristics are already well known.

A History of the Great War, 1914-1918. By C. R. F. M. CRUTTWELL. (Oxford University Press. 15*s.*)

There can scarcely be any question about the World War being a matter of interest for *Discovery*. The controversy raging over the opinions held about Passchendaele, the attacks made upon Mr. Lloyd George's memoirs, and his vigorous and convincing defence against these attacks prove that there is still ample scope for research even on the best known incidents of the War.

Mr. Cruttwell's book is a single volume of some 630 pages, supplied liberally with maps, with an appendix on casualties and an index. It represents an effort—a brilliantly successful effort—to present in one comprehensive narrative an account and picture of the whole War, military and naval, in every theatre, on every front. The outstanding problem which the author has had to deal with is scale, proportion; and he has accomplished what is probably the most difficult thing in the art of writing; he has given a coherent, lucid account (without the unreality of over-simplification) of a tremendous and crowded period, leaving out no essential matter, yet without burdening the narrative.

In addition to his capacity as writer and scholar, Mr. Cruttwell

has the experience of combatant service as an infantry officer in France. He is probably the last professional historian to write the history of the War who has himself taken an active part in it; other trained historians who fought have either said their say about it, or probably have no intention of doing so. It must be understood that Mr. Cruttwell's book is not memoirs; he has written a history of classical form and type with the additional distinction that, like Thucydides, he has witnessed, acted, felt, and suffered the grand and tragic drama which is his moving theme.

The outstanding features of this History, besides its clarity and comprehensiveness, are restraint, fairness, chivalry, and intense vividness. All the books of any note, written by men of all countries, have been read and assimilated, and the facts and conclusions are presented in such a way that it would be impossible for any reader, by internal inspection, to say with assurance to which side the author belonged. I know of no instance of such complete mental detachment, combined with deep emotion and sympathy, since Thucydides wrote his history of the Peloponnesian War. Chivalrous appreciation is accorded to Hindenburg, Falkenhayn, Ludendorff, and many other less-known soldiers and sailors of the Central Powers, as well as to Haig, Joffre, Foch, Pétain, Jellicoe, and Beatty, and others of the "Entente" side. Many of the pen portraits are obviously done from the life, and many of the judgments have been formed after conversations with high personalities of the War. The common man is by no means ignored, for Mr. Cruttwell looks for bravery and devotedness wherever they are to be found, and he honours the waves of heavily laden brave men, lumbering over broken ground into the hail of the machine-guns, whether they were British or French infantry, or the German soldiers who, he declares (p. 276), "man for man remained" (even after passing through the blood bath of Verdun) "the equal of any in the world."

Middlesex: Old and New. By MARTIN S. BRIGGS. (Allen & Unwin. 8*s.* 6*d.*)

To describe this as a depressing book is, oddly enough, a really high compliment. Anyone who was brought up in the more remote parts of the county of Middlesex and has seen the blight of "progress" oozing inevitably over the countryside which he regarded with affection cannot but be regretful, and Mr. Briggs records the spread of Suburbia with depressing accuracy: asphalte and pink asbestos tiles take the place of green lanes and black weatherboarded barns; and generation upon generation of newly-weds are tempted to 'come and live in leafy——." It is odd that they do not seem to realise that by the time a few hundred of them have responded to the invitation there is not much room for the leaves.

Yet Mr. Briggs leaves us some crumbs of comfort. In the first place the sort of publicity broadcast by books like this has awakened public authorities to a sense of their responsibility towards the amenities of the countryside—witness the recent proposals to safeguard one or more "green belts" around London—and secondly there still are some quite attractive spots remaining in Middlesex; and our author makes the most of these. In the west part of the county there are still such relics of ancient rural peace as Cranford Park, Heston lych-gate (perhaps the finest in England), and Harmondsworth churchyard. Mr. Briggs does not mention the fine group of yews here; we hope this does not mean that they have been cut down within the last few months. This is unlikely, as the District Council here, like that at Ruislip, receives due praise for its efforts towards preserving as far as possible the natural attractions of the neighbourhood. The spoliation of North Middlesex is perhaps most obvious, largely because it was such a particularly charming piece of country in its natural state. Whoever remembers, from before the War, the narrow lane leading to Kingsbury church in its little cul-de-sac, or the Georgian villas around Roe Green, or the steep-pitched lanes above Bittacy Hill, will be shocked at what he sees there now. Such old farm buildings as remain are rotting derelicts and hedgerows have disappeared wholesale before the asphalte-layer. Mr. Briggs faithfully records all this; and he has some hideous prophecies of the 1941 census. Increases of 150 per cent. in population have already been recorded.

The book is a very valuable record of a period of ultra-rapid transition from rural to urban conditions, occupying a unique position in social history. Mr. Briggs knows his county thoroughly, and he can descend to detail without being petty; every word is readable. The end-paper map is a revelation, and the local bibliographies at the end of each chapter are illuminating. They show how few people have taken the trouble to record the local history: here and there an enthusiast, now and again a council with an "Official Guide." Let us hope some of the hundreds of thousands of new Middlesex residents may be spurred on to research by the too-frequent entry "Books on Local History and Topography—Nil."

Turkestan Solo. By ELLA K. MAILLART; translated from the French by JOHN RODKER. (Putnam. 10*s.* 6*d.*)

This is the English version of *Des Monts Celestes aux Sables Rouges*, published in France in March, 1934. It would, perhaps, have been fitter if the title had been *Turkestan Sola*, for the author is a lady, a journalist who stresses the independence of her profession, enjoying a certain cosmopolitan training and origin, which give width to her outlook. This plucky girl went on a lone expedition into Soviet Turkestan, to the very borders of China and Afghanistan. She stubbornly overcame the numerous difficulties put in her way, and faced the hardships and possible dangers of the road, the huge discomforts, the vile food, the filth and the vermin, for a considerable period, without once boring the reader with her sufferings.

At the start we find her hobnobbing with Pilnyak and other Bolshevik highbrows, but when she leaves hackneyed ground for the east and gives us a detailed account of the present condition of the country, she becomes really interesting.

She soon learnt, like many others, to respect the nomads. It is hardly to be wondered that so observant a traveller found the Kirghiz superior to the Russians whom she met, retaining traces of a culture and a dignity that the latter never had. The nomads certainly have no grounds for loving their Russian masters, for such land as the Tsars left them has been taken by the Soviets, while both have tried to break their spirit and wean them from their pastoral existence, with its peculiar culture inherited from the very dawn of civilisation, in order to make peasants of them. But they prefer freedom. Fifty years ago well-meaning Russian officials ruined the Bashkirs in this way, morally as well as economically. The first step in the ruin of the Kirghiz and Kazaks has been the destruction of those vast herds of horses, camels, and sheep, for which they required the expanse of steppe where they evolved together.

In an interesting chapter Mlle. Maillart describes the trial of a

party of Basmachi, rebels who refused to accept the Soviets. The movement was a strong one, the clash of individuality with collectivism, and although the Bolsheviks claimed to have " liquidated " it by 1921, they were obliged to mobilise the entire air force of Turkestan several years later, to crush Djunaid Khan, the Turcoman leader. Even then the gallant old man defied them, and escaped into Afghanistan.

Mlle. Maillart tells us that the Soviets have introduced padlocks into the native life, which thing is an allegory, and she exposes the farce of the so-called autonomous republics, " nationalist in form, but proletarian in content," in the words of Stalin himself, in whom the author sees Russia's vengeance for the Tartar conquest of Muscovy. She shows up, too, the folly of dictators who dictate without understanding. Thus, the natives received orders to destroy their system of irrigation, on which depended the rice crop, the people's food, to make way for " the cotton front." When the authorities realised that it was unsuitable, they gave orders for rice to be grown again. But it will take many years' labour to restore those ancient irrigation canals.

There are interesting chapters on the history of Central Asia, though by a strange slip the Achaemenids are made the " first of the Samanids," who came twelve centuries later. But Mlle. Maillart is both observant and well-informed. She refers to Captain Burnaby's famous Ride to Khiva, and to the terrible fate of Colonel Stoddart and Captain Conolly in 1842 who, before public execution, in Bukhara, were tortured in the bug-pit. She might have added that the bug was *Reduvius fedschenkianus*, Osh. She alludes, too, to the *karakurt*, that is *Lathrodectus lugubris*, Koeb., the dreaded venomous spider of the desert. She sketches in a few words the appearance of unfamiliar birds, so that we may recognise the pastor, the roller, and the pelican on the wing. She tells us of an extraordinary fish common to the Amu Darya and the Mississippi, *Scaphirrhynchus*. Unlike some who write didactically upon the subject, Mlle. Maillart does not confuse either the nomenclature or the geography of the Turanian peoples.

There are some striking photographs, especially of native types, and she gives a lesson to many writers of travel books ; the " portrait of the author " is *a tergo*.

The translator has done his work well enough while dealing with the original French, but in Russian words and names flounders out of his depth. This is a pity, as reference to experts is easy and avoids monstrosities in the text. The English is not beyond reproach, for the mouflon is distinct from the argali, the German name *Steinbock* is unnecessary when we have the English word ibex, sheep do not have antlers, and the " Sohm " is not a member of the " Silurians," but of the *Siluridæ* : " enthused " is an unsuitable word for a dignified book of travel ; in the horse's pace which is rendered at one place by canter and another by jog-trot, we may, it seems, see the Russian word *inohod*, for which the English equivalent is lope or tripple. Barskaul, we presume, is a misprint for Barnaul.

General Astronomy. By HAROLD SPENCER JONES, F.R.S., Astronomer Royal. (Edward Arnold. 12*s*. 6*d*.)

Astronomy has developed so enormously during the past fifty years that astronomers, like other men of science, have been forced into the ranks of the specialists. Hence the writing of a book with so comprehensive a title as *General Astronomy* is not so easy a matter as it was when Sir John Herschel brought out his famous *Outlines* in 1849. Indeed, it is perhaps not too much to say that there is no astronomer living to-day who could hope to make, unaided, a perfectly satisfactory job of it. It must, therefore, be taken as more than faint praise when we say that Dr. Jones has, in the work before us, come as near to the ideal as any single astronomer could be expected to do. His *General Astronomy* is actually the second edition of a book first published in 1922 ; but it has been so thoroughly revised and amplified as to merit attention as practically a new work.

Much light has passed down our telescopes in the past twelve years, and in this new edition the author has had a good deal to add with regard to such subjects as planetary temperatures, the internal constitution of the stars, the rotation of the galaxy, and the structure of the universe. These additions, which bring his review right up to date, are a most valuable feature of the book, and serve to make it an indispensable guide to lecturers and others, who would otherwise have to search through the publications of learned societies in order to supplement the works of reference hitherto available. And it is not only for information concerning recent developments that the student will turn to this book, for it also deals fully, though in a simple and non-mathematical way, with the more permanent and fundamental facts of the science. Indeed, the author's treatment of the geometrical and dynamical aspects of his subject is really admirable. This is only what we should expect of an Astronomer Royal, and we are not disappointed.

It would, perhaps, be unfair to complain that some of the more practical and descriptive sides of the science are treated rather academically, for it is not to be expected that so distinguished a mathematician as Dr. Jones would have had the time or the inclination to spend more than a limited portion of his career at the eye-piece of a telescope. But the whole subject is really treated quite adequately for general purposes ; and this applies as much to astronomical instruments as to the observations made with them. The only regrettable feature in this section is the absence of any account of the spectrohelioscope ; and this omission is the more surprising when we remember that the Royal Observatory at Greenwich is one of the few institutions where this powerful new instrument is in regular use.

There is reason to fear that the reading of the proofs of this book has been somewhat hurriedly done. At any rate there is a rather large number of minor errors scattered throughout the work. A certain proportion of these are mere misprints, and obviously such : but there are others, in the nature of slips of the pen, which may well mislead a beginner as, for instance, where we read " noon " for " midnight," " rotation " for " revolution," and " poles " for " equator."

But, after all, these blemishes are relatively unimportant, as they can, and doubtless will, be removed in the next edition. Meanwhile, we can confidently recommend the Astronomer Royal's book as the most up-to-date and comprehensive review of astronomy at present available in the English language.

A Book of English Places. By A. L. SALMON. (Benn. 5*s*.)

This is not a book of topographic lore, but a book of memories : charming memories, mainly of Wessex and beyond, unconnected except by the author's personality. He tells of an England that is passing, an England that a few private individuals are striving to preserve in the face of a vast national indifference. Even since his writing of it, the work of deterioration has been going on ; and one of the last remaining rural stretches of the South Coast has developed a hideous eruption called " Bexington-on-Sea."

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